STATE LIBRARY OF PENNSYLVANIA
3 0144 00287930 2

E [illegible]
B [illegible] 4
v. 2

PENNSYLVANIA
1745
STATE ★ LIBRARY

Digitized by the Internet Archive
in 2016

https://archive.org/details/buffonsnaturalhi00buff_2

Barr's Buffon.

Buffon's Natural Hiſtory.

CONTAINING

A THEORY OF THE EARTH,

A GENERAL

HISTORY OF MAN,

OF THE BRUTE CREATION, AND OF

VEGETABLES, MINERALS,

&c. &c.

FROM THE FRENCH.

WITH NOTES BY THE TRANSLATOR.

IN TEN VOLUMES.

VOL. III.

London:
PRINTED FOR THE PROPRIETOR,
AND SOLD BY H. D. SYMONDS, PATERNOSTER-ROW

1797.

CONTENTS

OF

THE THIRD VOLUME.

Page

Hiſtory of Animals - 1

Chap. VI. *Experiments on the Method of Generation* - - 13

Chap. VII. *Compariſon of my Obſervations with thoſe of Leeuwenhoek* 134

Chap. VIII. *Reflections on the preceding Experiments* - - 159

Chap. IX. *Varieties in the Generation of Animals* - - 208

Chap. X. *On the Formation of the Fœtus* 226

Chap. XI. *On the Expanſion, Growth, and Delivery of the Fœtus* - 260

Recapitulation - - 309

Hiſtory of Man.

Chap. I. *Of the Nature of Man* - 317

Chap. II. *Of Infancy* - - - 334

55363

Directions for placing the Plates.

Page 88, Fig. 1, 2, 3, 4, 5, 6.
106, Fig. 7, 8, 9, 10, 11, 12.
140, Plate III.
148, Plate IV.

BUFFON'S

NATURAL HISTORY.

HISTORY OF ANIMALS.

ARISTOTLE admits, with Plato, of final and efficient cauſes. Theſe efficient cauſes are ſenſitive and vegetative ſouls, that give form to matter, which of itſelf is only a capacity of receiving forms; and as in generation the female gives the moſt abundant matter, and it being againſt his ſyſtem of final cauſes to admit that what one could affect ſhould be performed by many, he concludes, that the female alone contains the neceſſary matter to generation; and, as another of his principles was, that matter itſelf is unformed, and that form is a diſtinct being from matter, he affirmed that the male furniſhed the form, and conſequently nothing belonged to matter.

Deſcartes, on the contrary, who admitted but a few mechanical principles in his philoſophy, endeavoured to explain the formation of the fœtus by them, and thought it in his power to comprehend, and make others underſtand, how an organized and living being could be made by the laws of motion alone. His admitted principles differed from thoſe uſed by Ariſtotle; but both, inſtead of examining the thing itſelf, without prepoſſeſſion and prejudice, have only conſidered it in the point of view relative to their ſyſtems of philoſophy, which could not be attended with a ſucceſsful application to the nature of generation, becauſe it depends, as we have ſhewn, on quite different principles. Deſcartes differs ſtill more from Ariſtotle, by admitting of the mixture of the ſeminal liquor of the two ſexes; he thinks both furniſh ſomething material for generation, and that the fermentation occaſioned by the mixture of theſe two ſeminal liquors cauſes the formation of the fœtus.

Hippocrates, who lived under Perdicas, a conſiderable time before Ariſtotle, eſtabliſhed an opinion, which was adopted by Galen, and a great number of phyſicians who followed him. His opinion was, that the male and female had each a prolific fluid, and ſuppoſed, beſides, that there were two ſeminal fluids in each ſex, the one ſtrong and active, the other weak and inactive *. That a mixture of the two ſtrongeſt fluids produced a male child, and of the two weakeſt a female; ſo that, according to him, they each contain a male and a female ſeed. He ſupports this hypotheſis by the following circumſtance; that many women, who produced only girls by their firſt huſbands, have produced boys by a ſecond; and that men, who have had only girls by their firſt wives, have had boys by others. It appears to me, that if even this circumſtance could be well eſtabliſhed, it would not be neceſſary to give to the male and female two kinds of ſeminal liquor for an explanation, becauſe it may eaſily be conceived that women,

who

---

[*] See Hippocrates, lib. de Genitura, page 129. & lib. de diæta, page 198, Lugd. Bat. 1665, vol. I.

who have brought forth only girls by their firſt huſbands, and produced boys with other men, were only thoſe who furniſhed more particles proper for generation with their firſt huſband than with the ſecond; or that the ſecond huſband furniſhed more particles proper for generation with the ſecond wife than with the firſt; for when, in the inſtant of conception, the organic molecules of the male are more abundant than thoſe of the female, the reſult will be a male, and when thoſe of the female abounds a female will be produced; nor is it in the leaſt ſurpriſing that a man ſhould have a diſadvantage in this reſpect with ſome women, while he will have a ſuperiority over others.

This great phyſician ſuppoſes, that the ſeed of the male is a ſecretion of the ſtrongeſt and moſt eſſential parts of all that is humid in the human body; and he thus explains how this ſecretion is made: "Venæ & nervi, he ſays, ab omni corpore in pudendum vergunt, quibus dum aliquantulum teruntur & caleſcunt ac implentur, velut pruritus incidit, ex hoc toti corpori voluptas ac caliditas accidit; quum vero pudendum teritur & homo movetur, humidum in corpore caleſcit ac diffunditur, & a motu conquaſſatur ac ſpumeſcit, quem-admodum alii humores omnes conquaſſati ſpumeſcunt.

"Sic autem in homine ab humido ſpumeſcente id quod robuſtiſſimum eſt ac pinguiſſimum ſecernitur, & ad medullam ſpinalem venit; tendunt enim in hanc ex omni corpore viæ, & diffundunt ex cerebro in lumbus ac in totum corpus & in medullum; & ex ipſa medull proacedunt viæ. ut & ad ipſam humidum perferatur & ex ipſa ſecedat; poſtquam autem ad hanc medullam genitura pervenerit, procedit ad renes, hac enim via tendit per venas, & ſi renes fuerint exulcerati, aliquando etiam ſanguis defertur: a renibus autem tranſit per medois teſtes in pudendum, proce dit autem non qua urina, erum alia ipſi via eſt illi contigua, &c *."

Anatomiſts will no doubt diſcover that Hippocrates is not correct in tracing the road of the ſeminal liquor; but that does not affect his opinion, that the ſemen comes from every part of the body, and particularly the head, becauſe, he ſays, thoſe whoſe veins have been cut which lie near the ears only bring forth a weak, and very often an unfertile ſemen. The female has alſo a ſeminal fluid which ſhe emits, ſometimes within the matrix and ſometimes without, when

---

* See Fœſius's Tranſlation, vol. I. page 129.

when the internal orifice is more open than it ſhould. The ſemen of the male enters into the matrix, where it mixes with that of the female; and as each has two kinds of fluid, the one ſtrong and the other weak, if both furniſh their ſtrong, a male will be the reſult, and if their weak, a female; and if in the mixture there are more particles of the male liquor than the female, then the infant will have a greater reſemblance to the father than to the mother, and ſo on the contrary. It might here be aſked Hippocrates what would happen when the one furniſhed its weak ſemen and the other its ſtrong? I cannot conceive what anſwer he could make, and that alone is ſufficient to cauſe his opinion of two ſeeds in each ſex to be rejected.

In this manner then, according to him, the formation of the fœtus is made: the ſeminal fluids firſt mix in the matrix, where they gradually thicken by the heat of the body of the mother; the mixture receives and attracts the ſpirit of the heat, and when too warm part of the heat flies out, and the reſpiration of the mother ſends a colder ſpirit in; thus alternatively a cold and a hot ſpirit enter the mixture, which give life, and cauſe a pellicle to grow on the ſurface, which takes a round form, becauſe the ſpirits, acting as a centre, extend it equally on all ſides. "I have ſeen, ſays this great man, a fœtus of ſix days old; it was a ball of liquor ſurrounded with a pellicle; the liquor was reddiſh, and the pellicle was ſpread over with veſſels, ſome red and others white, in the midſt of which was a ſmall eminence, which I thought to be the umbilical veſſels, by which the fœtus receives nouriſhment and the ſpirit of reſpiration from the mother. By degrees another pellicle is formed, which ſurrounds the firſt; the menſtrual blood, being ſuppreſſed, abundantly ſupplies it with nutriment, and which coagulates by degrees, and becomes fleſh; this fleſh articulates itſelf in proportion as it grows, and receives its form from the ſpirit; each part proceeds to take its proper place; the ſolid particles go to their reſpective ſituations and the fluid to theirs: each matter ſeeks for that which is moſt like itſelf, and the fœtus is at length entirely formed by theſe cauſes and theſe means."

This ſyſtem is leſs obſcure and more reaſonable than that of Ariſtotle, becauſe Hippocrates endeavours to explain every matter by particular reaſons: he borrows from the philoſophy of his times but one ſingle principle, which is, that heat and cold produce ſpirits, and that thoſe ſpirits have the power of ordering and arranging matter. He has viewed generation more like a phyſician than a philoſopher, while Ariſtotle has explained it more like a metaphyſician than a naturaliſt; which makes the defects of Hippocrates's ſyſtem particular and leſs apparent, while thoſe of Ariſtotle's are general and evident.

Theſe two great men have each had their followers; almoſt all the ſcholaſtic philoſophers, by adopting Ariſtotle's philoſophy, received his ſyſtem of generation, while almoſt every phyſician followed the opinion of Hippocrates; and ſeventeen or eighteen centuries paſſed without any thing new being ſaid on the ſubject. At laſt, at the reſtoration of literature, ſome anatomiſts turned their eyes on generation, and Fabricius Aquapendente was the firſt who made experiments and obſervations on the impregnation and growth of the eggs of a fowl. The following is the ſubſtance of his obſervations.

He diſtinguiſhed two parts in the matrix of a hen, the one ſuperior and the other inferior. The ſuperior he calls the Ovarium, which is properly no other than a cluſter of ſmall yellow eggs of a round form, varying in ſize from the bigneſs of a muſtard-ſeed to that of a large nut or medlar. Theſe ſmall eggs are faſtened together by one common pellicle, and form a body which nearly reſembles a bunch of grapes. The ſmalleſt of theſe eggs are white, and they take another colour in proportion as they increaſe.

Having examined theſe eggs immediately after the communication of the cock, he did not perceive any remarkable difference, nor any of the male ſemen in any one of theſe eggs; he therefore ſuppoſed that every egg, and the ovarium itſelf, became fruitful by a ſubtle ſpirit, which came from the ſemen of the male; and he ſays, that in order to ſecure this fecundating ſpirit, nature has placed at the external orifice of the vagina of birds a kind of net-work or membrane, which permits, like a valve, the entrance of this ſeminal ſpirit, but at the ſame time prevents it from re-iſſuing or evaporating.

When the egg is looſened from the common pellicle, it deſcends by degrees through a winding paſſage into the internal part of the matrix. This paſſage is filled with a liquor nearly ſimilar to the white of an egg; it is alſo in this part that the eggs begin to be ſurrounded with this white liquor, with the membrane whhich occaſions it, the two ligaments *(chalazæ)* which paſſes over the white, and connects it with the yolk and ſhell, which are formed in a very ſhort time before they are laid. Theſe ligaments, according to Fabricius, is the part of the egg fecundated by the ſeminal ſpirit of the male; and it is here where the fœtus firſt begins to form. The egg is not only the true matrix, that is to ſay, the place of the formation of the chick, but it is from the egg all generation depends. The egg produces it as the agent; it ſupplies both the matter and the organs; the ligaments are the ſubſtance of formation; the white and the yolk are the nutriment, and the ſeminal ſpirit of the male is the efficient cauſe. This ſpirit communicates to the ligaments at firſt an alterative faculty, afterwards a formative, and laſtly the power of augmentation, &c.

Theſe obſervations of Fabricius have not given us a very clear explication of generation. Nearly at the ſame time as this anatomiſt was employed in theſe reſearches, towards the middle of the ſixteenth century, the famous

Aldrovandus [*], alſo made obſervations on eggs; but as Harvey judiciouſly obſerves, he followed Ariſtotle much cloſer than experiment. The deſcriptions he gives of the chicken in the egg are not exact. Volcher Coiter, one of his ſcholars, ſucceeded much better in his enquiries; and Pariſanus, a phyſician of Venice, having alſo laboured on this ſubject, they have each given a deſcription of the chicken in the egg, which Harvey prefers to any other.

This famous anatomiſt, to whom we are indebted for the diſcovery of the circulation of the blood, has compoſed a very extenſive treatiſe on generation; he lived towards the middle of the laſt century, and was phyſician to Charles I. of England. As he was obliged to follow this unfortunate prince in his misfortunes, he loſt what he had written on the generation of inſects among other papers, and he compoſed what he has left us on the generation of birds and quadrupeds from his memory. I ſhall conciſely relate his obſervations, his experiments, and his ſyſtem.

Harvey aſſerts that man and every animal proceed from an egg; that the firſt produce of conception in viviparous animals is a kind of

---

[*] See his Ornithology.

of an egg, and that the only difference between viviparous and oviparous is, that the fœtus of the firſt take their origin, acquire their growth, and arrive at their entire expanſion in the matrix; whereas the fœtus of oviparous animals begins to exiſt in the body of the mother, where they are merely as eggs, and it is only after they have quitted the body of the mother that they really become fœtuſes; and we muſt remark, ſays he, that in oviparous animals, ſome hold their eggs within themſelves till they are perfect, as birds, ſerpents, and oviparous quadrupeds; others lay their eggs before they are perfect, as fiſh, cruſtaceous, and teſtaceous animals. The eggs which theſe animals depoſit are only the rudiments of real eggs, they afterwards acquire bulk and membranes, and attract nouriſhment from the matter which ſurrounds them. It is the ſame, adds he, with inſects, for example, and caterpillars, which only ſeem imperfect eggs, which ſeek their nutriment, and at the end of a certain time arrive to the ſtate of chryſalis, which is a perfect egg. There is another difference in oviparous animals: for fowls and other birds have eggs of different ſizes, whereas fiſh, frogs, &c. lay them before they are perfect,

fect, have them all of the ſame ſize ; he indeed obſerves, that in pigeons, who only lay two eggs, all the ſmall eggs which remain in the ovarium are of the ſame ſize, and it is only the foremoſt two which are bigger than the reſt. It is the ſame, he ſays, in cartilaginous fiſh, as in the thornback, who have only two eggs which increaſe and come to maturity, while thoſe which remain in the ovarium are, like thoſe in fowls, of different ſizes.

He afterwards makes us an anatomical expoſition of the parts neceſſary to generation, and obſerves, that in all birds the ſituation of the anus and vulra are contrary to the ſituation of thoſe parts in other animals; the anus being placed before and the vulra behind * ; and with reſpect to the cock, and all ſmall birds, that they generate by external friction, having in fact no intermiſſion nor real copulation ; with male ducks, geeſe, and oſtriches, it is evidently otherwiſe.

Hens produce eggs without the cock, but in a very ſmall number, and theſe eggs, although perfect, are unfruitful ; he does not agree with the opinion of country people, that two or three days cohabitation with the cock is

---

* Moſt of theſe articles are taken from Ariſtotle.

is ſufficient to impregnate all the eggs an hen will lay within the year, but admits that he ſeparated a hen from a cock for the ſpace of twenty days, and that all the eggs ſhe laid during that ſpace were fecundated. While the egg is faſtened to the ovarium, it derives its nutriment from the veſſel of the common pellicle, but as ſoon as it is looſened from it, it derives the white liquor which fills the paſſages in which it deſcends, and the whole, even to the ſhell, is formed by this mode.

The two ligaments *(chalazæ)* which Aquapendente looks on as the ſhoot produced by the ſeed of the male, are found in the infecund eggs which the hen produces without the communication with the cock, as in thoſe which are impregnated: and Harvey very judiciouſly remarks, that thoſe parts do not proceed from the male, and are not thoſe which are fecundated; the fecundated part of an egg is a very ſmall white circle which is on the membrane that covers the yolk, and forms there a ſmall ſpot, like a cicatrice, about the ſize of a lentil. Harvey alſo remarks, that this little cicatrice is found in every fecund or infecund egg, and that thoſe who think it is produced by the ſeed of the male are deceived. It is of the ſame ſize and form in freſh eggs, as in thoſe which have been kept a-long time; but when we would hatch them, and when the egg receives a ſufficient degree of heat, either by the hen, or artificially, we preſently ſee this ſmall ſpot increaſe and dilate nearly like the ſight of the eye. This is the firſt change, and is viſible at the end of a few hours incubation.

When the egg has undergone a proper warmth for twenty-four hours, the yolk, which was before in the centre of the ſhell, approaches nearer to the cavity at the broad end; this cavity is encreaſed by the evaporation of the watery part of the white, and the groſſer part ſinks to the ſmall end. The cicatrice, or ſpeck, on the membrane of the yolk, riſes with it to the broad end, and ſeems to adhere to the membrane there: this ſpeck is then about the bigneſs of a ſmall pea, in the middle of it a white ſpeck is diſcernible, and many circles, of which this point ſeems to form the centre.

At the end of the ſecond day theſe circles are larger and more viſible; the ſtreak alſo appears divided by theſe circles into two, and ſometimes three parts of different colours; a ſmall protuberance alſo appears on the external part, and nearly reſembles a ſmall eye, in the pupil of which there is a point, or little cataract; between theſe circles a clear liquor is contained by a very delicate membrane, and the ſpeck now appears to be placed more in the white than on the membrane of the yolk. On the third day the tranſparent liquor is conſiderably encreaſed, as is alſo the ſmall membrane which ſurrounds it. The fourth day, a ſmall ſtreak of purple-coloured blood is obſerved at the circumference of the ſpeck or ball, at a little diſtance from the centre of which a point may be ſeen of a blood colour, and which beats like a heart. It appears like a ſmall ſpark at each diaſtole, and diſappears at each ſyſtole; from this animated ſpeck iſſue two ſmall blood veſſels, which theſe ſmall veſſels throw out as branches into this liquor, all of which come from the ſame point, nearly in like manner as the roots of a tree ſhoot from from the trunk.

Towards the end of the fourth day, or at the beginning of the fifth, the animated ſpeck is ſo much encreaſed as to appear like a ſmall bladder filled with blood, and by its contractions and dilations is alternatively filled and emptied. In the ſame day this veſſel very diſtinctly appears to divide into two parts, each of which alternatively impel and dilute the blood in the ſame manner. Around the ſhorteſt ſanguinary veſſel which we have ſpoken of a kind of cloud is ſeen, which although tranſparent, renders the ſight of this veſſel more obſcure; this cloud conſtantly grows thicker and more attached to the root of the blood veſſel, and appears like a ſmall globe; this ſmall globe lengthens and divides into three parts, one of which is globular, and larger than the other two; the head and eyes now begin to appear, and at the end of the fifth day, the place for the vertebra is ſeen in the remainder part of this globe.

The ſixth day the head is ſeen more clearly, the outlines of the eyes now appear, the wings and thighs lengthen, and the liver, lungs, and beak, are diſtinctly obſerved; the fœtus now begins to move and extend its head, although it has as yet only the internal viſcera; for the thorax, abdomen, and all the external coverings of the fore part of the body is wanting. At the end of this day, or at the beginning of the ſeventh, the toes appear, the chick opens and moves its beak, and the anterior parts of the body begin to cover the viſcera; on the ſeventh day the chicken is entirely formed, and from this time until it comes out of the egg, nothing happens but only an expanſion of thoſe parts it acquired within theſe firſt ſeven days; at the fourteenth or fifteenth day the feathers appear, and at the twenty-firſt it breaks the ſhell with its beak, and procures its enlargement.

Theſe obſervations of Harvey appear to have been made with the greateſt exactneſs; nevertheleſs we ſhall point out how imperfect they are, and that he has fallen himſelf into the error he reproaches others with, making experiments to ſupport his favourite hypotheſis, that the heart was the animated ſpeck which firſt appeared; but before we proceed on this matter, it is but juſt to give an account of his other obſervations, and of his ſyſtem.

It is well known that Harvey made many experiments on hinds and does. They receive the male towards the middle of September: a few days after copulation the horns of the matrix become thicker, and at the ſame time more lax. In each of the cavities five caruncula appear. Towards the 26th or 28th of the above month the matrix thickens ſtill more, and the five carunculas are ſwelled nearly to the ſhape and ſize of a nurſe's nipple; by opening them an infinity of ſmall white ſpecks are found. Harvey pretends to have remarked, that there was neither then, nor immediately after copulation, any alteration or change in the ovarium, and that he has never been able to find a ſingle drop of the ſeed of the male in the matrix, although he has made many reſearches for that purpoſe.

Towards the end of October, or beginning of November, when the females ſeparate from the males, the thickneſs of the horns begins to diminiſh, the internal ſurfaces of their cavities are ſwelled, and appear faſtened together; the caruncula remain, and the whole, which reſembles the ſubſtance of the brain, is ſo ſoft that it cannot be touched. Towards the 13th or 14th of November, Harvey ſays, that he perceived filaments, like the threads of a ſpider's web, which traverſed the cavities of the horns and the matrix itſelf: theſe filaments ſhoot out from the ſuperior angle of the matrix, and by their multiplication form a kind of membrane, or empty tunic; a day or two after this tunic is filled with a white, aqueous and glutinous matter, which adheres to the matrix by a kind of mucilage; and in the third month this tunic, or pouch, contains an embryo about the breadth of two fingers long, and another internal pouch, called the amnios, containing a tranſparent cryſtalline liquor, in which the fœtus ſwims. The fœtus at firſt was but an animated ſpeck, like that in the egg of a fowl. All the reſt is performed in the ſame manner as that related of the chick; the only difference is in the eyes, which appear much ſooner in the fowl than in the deer. The animated ſpeck appears about the 19th or 20th of November, a day or two after which the oblong body, which contains the fœtus, is ſeen; in ſix or ſeven days more it is ſo much formed that the ſex and limbs may be diſtinguiſhed; but the heart and viſcera are yet uncovered, and it is two days more before the thorax and the abdomen covers them, which is the laſt work and completion of the edifice.

From theſe obſervations upon hens and deer Harvey concludes, that all female animals have eggs, that in theſe eggs a ſeparation of a tranſparent chryſtalline liquor contained in the amnios is made, and that another external pouch, the chorion, contains the whole liquors of the egg; that the firſt thing which appears in the chryſtalline liquor is the ſanguinary and animated ſpirit; in a word, that the formation of viviparous animals is made after the ſame manner as oviparous; and he explains the generation of both as follows:

Generation is the work of the matrix, in which no ſeed of the male ever enters; the matrix conceives by a kind of contagion, which the male liquor communicates to it, nearly as the magnet communicates its magnetic virtue to ſteel. This male contagion not only acts upon the matrix but over all the female body, which is wholly fecundated, although the matrix only has the faculty of conception, as the brain has the ſole faculty of conceiving ideas. The ideas conceived by the brain are like the images of the objects tranſmitted by the ſenſes; and the fœtus, which may be conſidered as the idea of the matrix, is like that which produces it. This is the reaſon that a child has a reſemblance to its father, &c.

I ſhall not follow this anatomiſt any farther; what I have mentioned is ſufficient to judge of his ſyſtem; but we have ſome remarks to make on his obſervations. He has given them in a manner moſt likely to impoſe; ſeems to have often repeated his experiments, and to have taken every neceſſary precaution to avoid deception; from which it might be imagined he had ſeen all he writes upon, and obſerved them with the greateſt accuracy. Nevertheleſs, I perceive both uncertainty and obſcurity in his deſcriptions; his obſervations are related chiefly on memory; and although he often ſays the contrary, Ariſtotle appears to have been his guide more than experience; for he has only ſeen in eggs what Ariſtotle has before mentioned; and that moſt of his obſervations which may be deemed eſſential had been made before him, we ſhall be perfectly convinced if we pay a little attention to what follows:

Ariſtotle knew that the ligaments (Chalazæ) were of no ſervice to the generation of the chicken. "Quæ ad principium lutei grandines hærent, nil conferunt ad generationem, ut quidam ſuſpicantur." * Pariſanus, Volcher, Coiter, Aquapendente, and others, remarked the cicatrice as well as Harvey, Aquapendente ſuppoſed it of no uſe; but Pariſanus pretended, that it was formed by the male ſemen, or at leaſt that the white ſpeck in the middle of the cicatrice was the ſeed of the male which would produce the chicken. "Eſt-que, ſays he, illud galli ſemen alba & tenuiſſima tunica abductum, quod ſubſtat duabus communibus toti ovo membranis, &c." Therefore the only diſcovery which properly belongs

---

* Hiſt. Anim. lib. vi. cap. 2.

longs to Harvey is, his having obſerved that this cicatrice is found in infecund as well as fecundated eggs; for others had obſerved, like him, the dilation of the circles, and the growth of the white ſpeck; and it appears that Pariſanus had ſeen it much better; this is all which he remarks in the two firſt days of incubation; and what he ſays of the third day, is only a repetition of Ariſtotle's words. * "Per id tempus aſcendit jam vetellus ad ſuperiorem partem ovi acutiorem, ubi & principium ovi eſt & fœtus excluditur; corque ipſum apparet, in albumine ſanguinei puncti, quod punctum ſalit & movet ſeſe inſtar quaſi animatum; ab eo meatus venarum ſpecie duo, ſanguinei pleni, flexuoſi, qui, creſcente fœtu, feruntur in utramque tunicam ambientem, ac membrana ſanguineas fibras habens eo tempore albumen continet ſub meatibus illis venarum ſimilibus; ac paulo poſt diſcernitur corpus puſillum initio, omnino & candidum, capite conſpicuo, atque in eo oculis maxime turgidis qui diu ſic permanent, ſero enim parvi fiunt ac conſidunt. In parte autem corporis inferiore, nullum extat membrum per initia, quod reſpondeat ſuperioribus. Meatus autum illi qui a corde prodeunt,

---

* Hiſt. Anim. lib. vi. cap 4.

deunt, alter ad circumdantem, membranam tendit, alter ad luteum, officio umbilici."

Harvey attacks Ariſtotle for ſaying that the yolk aſcends towards the ſmall end of the egg, and concludes, that he had not ſeen any thing himſelf, but had apparently received his information from ſome good obſerver of Nature. Harvey was wrong in thus reproaching Ariſtotle, and in aſſerting that the yolk always aſcends towards the broad end of the egg, for that depends on the poſition of the egg during the time of incubation, for the yolk always aſcends to the uppermoſt part, as being lighter than the white, whether it be to the broad or the ſmall end. William Langley, a phyſician at Dordrecht, who made obſervations on the hatching of eggs, in 1655, twenty years before Harvey, was the firſt who made this remark *.

But to return to the paſſage we have quoted. By that we ſee that the chryſtalline liquor, the animated ſpeck, the two circles, the two blood veſſels, &c. are deſcribed by Ariſtotle preciſely as Harvey had ſeen them. This anatomiſt alſo pretends that the animated ſpeck is the heart, that this heart is formed the firſt, and that

---

* See Wm. Langley Obſerv. edæ a juſto Schradero, Amſt. 1674.

that the viſcera and other parts are joined afterwards. All this has been ſpoken of by Ariſtotle, and ſeen by Harvey, and nevertheleſs it is not conformable to truth. To be aſſured of this we need only repeat the ſame experiments on eggs, or only read with attention thoſe of Malpighius *, which were made about 40 years after thoſe of Harvey.

This excellent obſerver of Nature examined, with attention, the cicatrice, which is the eſſential part of the egg; he found it was large in all impregnated eggs, and ſmall in thoſe which were not impregnated; and he diſcovered in eggs which had never been ſat upon, that the white ſpeck, ſpoken of by Harvey as the firſt which becomes animated, is a ſmall pouch or ball, which ſwims in a liquor incloſed by the firſt circle, and in the middle of this ball he obſerved the embryo. The membrane of this ſmall pouch, which is the amnios, being very thin and tranſparent, permitted him eaſily to ſee the fœtus it ſurrounded. Malpighius, with reaſon, concludes, from this firſt obſervation, that the fœtus exiſts in the egg before incubation, and that its firſt outlines are then very ſtrong. It is not neceſſary to point out how oppoſite this experiment

---

* Malpighii pullus in ovo.

ment is to the opinion of Harvey, for he ſaw nothing of a form for the two firſt days of incubation, and it was the third day before the ſign of the fœtus appears, which is the animated ſpeck: whereas according to Malpighius, the outlines of the fœtus exiſt in the egg before incubation has commenced.

After being aſſured of this important matter, Malpighius examined, with like attention, the cicatrice of unimpregnated eggs, which, as we have obſerved, is ſmaller than thoſe which have been impregnated; it has often irregular circumſcriptions, and ſometimes differs in different eggs. Near its centre, inſtead of the ball that incloſes the fœtus, there is a globular mole, which does not contain any thing organized, and which being opened does not preſent any thing formed or arranged, but only ſome appendages filled with a thick but tranſparent fluid; and this unſhapen maſs is ſurrounded with many concentric circles.

After ſix hours incubation the cicatrice is conſiderably dilated, and the ball formed by the amnios is eaſily diſcovered; this ball is filled with a liquor, in the middle of which the head of the chicken and back-bone are diſtinctly ſeen. In about ſix hours more the little animal

mal is ſeen more diſtinctly; in another ſix hours the head is grown larger, and the ſpine lengthened; and at the end of twenty-four hours the neck begins to lengthen, the vertebræ of the back appears of a white colour, and the head to turn to one ſide. The vertebræ are diſpoſed on each ſide of the ſpine, like ſmall globules; and almoſt at the ſame time the ſmall wings begin to ſhoot, and the head, neck, and breaſt are lengthened. After thirty hours nothing new appears, but every part of the little animal is conſiderably encreaſed, eſpecially the *amnios*. Around this membrane the umbilical veſſels are ſeen of a darkiſh colour. At the end of thirty-eight hours, the chicken being grown much larger, its head is large, and in which are diſtinguiſhed three veſſels ſurrounded with membranes, which alſo cover the back bone, through which the vertebræ are ſtill ſeen. In forty hours, continues Malpighius, it was wonderful to ſee the chicken alive, floating in the liquor; the back bone was encreaſed, the head was turned on one ſide, the veſicles of the brain were leſs apparent, the firſt outlines of the eyes appeared, the heart beat, and the circulation of the blood was begun. Malpighius then gives the deſcription of the veſſels and courſe of the blood, and reaſonably ſuppoſes that, though the heart does not beat before thirty-eight or forty hours incubation, it ſtill exiſted before that time, like the other parts of the chicken; but on examining the heart in a dark room, he diſcovered not the leaſt glimpſe of light to proceed from it, as Harvey inſinuates.

At the end of two days the chicken is ſeen floating in the liquor of the amnios; in which the head, compoſed of veſicles, is turned on one ſide; the back bone and vertebræ are lengthened; the heart, which then hung out of the breaſt, beat three times; for the fluid it contains is impelled into the ventricles of the heart, from thence into the arteries, and afterwards into the umbilical veſſels. He remarks, that having ſeparated the chick from the white of the egg, the motion of the heart ſtill continued for a whole day. After two days and fourteen hours, or ſixty-two hours of incubation, the chicken, although grown ſtronger, remained with its head bent downwards in the liquor contained by the amnios; the veins and arteries were ſeen among the veſſels of the brain; the lineaments of the eyes, and the ſpinal marrow alſo appear extending the length of the vertebræ.

At the end of the third day the head of the chichen appeared crooked; beſides the eyes five veſſels were ſeen in the head, filled with a liquid matter; the firſt outlines of the wings and thighs were to be diſtinguiſhed, and the body began to gather fleſh; the pupil of the eye, and alſo the chryſtalline and vitreous humour were diſcernible. At the fourth day the veſicles of the brain were nearer each other; the eminences of the vertebræ were more prominent, the wings and thighs aſſumed a greater ſolidity as they increaſed in length; the whole body, covered with a jelly like fleſh, was now ſurrounded within the body by a thin membrane, and the umbilical veſſels that unite the animal to the yolk, appeared to come from the abdomen. On the fifth and ſixth days the veſicles of the brain began to be covered; the ſpinal marrow, divided into two parts, began to take ſolidity and ſtretch along the trunk; the wings and thighs lengthened; the feet began to ſpread; the belly was cloſed up and tumid; the liver was diſtinctly ſeen, and appeared of a duſky white; the ventricles of the heart were diſcerned to beat very diſtinctly; the body of the chicken was covered with a ſkin, and the traces of the feathers were viſible; the ſeventh day the head appeared very large, the brain was entirely covered with its membranes; the beak began to appear betwixt the eyes, and the wings, the thighs, and the legs, had acquired their perfect figure.

I ſhall not follow Malpighius any farther, as the remainder relates only to the expanſion of the parts till the twenty-firſt day, when the chicken breaks the ſhell with its beak; though before that time it is heard to chirrup in its impriſonment. The heart is the laſt part which receives its proper form, for it is eleven days before the arteries are ſeen to join, and the ventricles become perfectly conformable and united.

We are now in a condition to judge of the value of Harvey's experiments and obſervations. There is great appearance this anatomiſt did not make uſe of a microſcope, which in fact was not brought to perfection in his days, or he would not have aſſerted there was no difference between the cicatrice of an impregnated and an unimpregnated egg; he would not have ſaid the ſeed of the male produced no alteration in the egg, eſpecially in the cicatrice ; he would not have affirmed that nothing was perceptible till the third day, that the animated ſpeck was the firſt that appeared, and into which the white ſpeck was changed. He would have ſeen that the white ſpeck was a ball which contained the whole apparatus of generation, and that every part of the fœtus are there from the moment the hen has connection with the cock. He would alſo have learnt, that without this connection it contains only an unſhapen maſs, which could never become animated, becauſe in fact it is not organized like an animal, and becauſe it is only when this maſs, which we muſt look upon as an aſſemblage of the organic particles of the female ſemen, is penetrated by the organic particles of the male ſemen, that there reſults from it an animal, which is formed at the moment, but whoſe motion is imperceptible till the end of forty hours after : he would not have aſſerted that the heart is firſt formed, and that the other parts are joined to it by a juxtapoſition, ſince it is evident from Malpighius's obſervations, that the outlines of every part are all immediately formed, but only appear in proportion as they dilate ; on the whole, if he had ſeen what Malpighius ſaw, he would not have affirmed that no impreſſion of the male ſeed remained in the eggs, and that it was only by contagion that they are fecundated, &c.

It is alſo juſt to remark, that what Harvey has ſaid on the parts of the generation of a cock is not exact; he aſſerts that the cock has no genital member, and that there is no intromiſſion; nevertheleſs it is certain that this animal, inſtead of one has two, and that they both act at the ſame time, and which action is a very ſtrong compreſſion, if not a true copulation *; and it is by this double organ that the cock emits the ſeminal liquor into the matrix of the hen.

Let us now compare the experiments made by Harvey on hinds with thoſe of De Graaf on doe rabbits; we ſhall find that although De Graaf ſuppoſes, with Harvey, that all animals proceed from eggs, yet there is a great difference in the mode which theſe two anatomiſts have obſerved in the firſt ſteps of formation, or rather expanſion, of the fœtuſes of viviparous animals.

After having exerted every effort to eſtabliſh, by reaſons drawn from comparative anatomy,

---

* See Reyn. Graaff, page 242.

tomy, that the teſticles of viviparous females are real ovaries, De Graaf explains how the eggs are looſened from the ovaries and fall into the horns of the matrix; he then relates what he obſerved in a rabbit, which he diſſected half an hour after copulation. The horns of the matrix, he ſays, were more red than before, but no other change in the reſt of the parts: there was alſo no appearance of any male ſeed, neither in the vagina, matrix, nor horns of the matrix.

Having diſſected another ſix hours after copulation he obſerved the follicules, or coats, which he ſuppoſes contained the eggs in the ovary, were become red, but found no male ſeed either in the ovaria or elſewhere. He diſſected another twenty-four hours after copulation, and remarked in one ovarium three, and in the other five follicules that were changed, the tranſparency being become dark and red. In one diſſected twenty-ſeven hours after copulation he perceived the horns of the womb had become more red and ſtrictly embraced the ovaries. In another, that he opened forty hours after copulation, he found in one of the ovaries ſeven follicules, and in the other three that were changed. Fifty-two hours after copulation he examined another and found one follicle changed in one of the ovaries and four in another, and having opened theſe follicules he found a glandular liquor, in the middle of which there was a ſmall cavity, where he did not perceive any liquor, which made him ſuppoſe that the tranſparent liquor, commonly contained in the follicules, and which, he ſays, is encloſed in its own membranes, might have been ſeparated by a kind of rupture: he ſearched after this matter in the paſſages, and in the horns of the matrix themſelves, but he found none; he only perceived that the internal membrane of the horns of the matrix was very much ſwelled. In another, diſſected three days after copulation, he obſerved, that the ſuperior extremity of the paſſage, which communicates with the horns of the matrix, ſtrictly embraced the ovaries; and having ſeparated it he perceived three follicules, longer and harder than uſual. After ſearching with the greateſt attention the paſſages abovementioned he found in the right paſſage one egg, and in the right horn of the matrix two more, not bigger than a grain of muſtard-ſeed: thoſe little eggs were each cloſed in double membranes, and the inner one was filled with a very a very limpid liquor. Having examined the other ovarium he found four follicules that were changed, three of which were white and had a little liquor within them; but the fourth was of a darker colour, and contained no liquor, which made him judge that from this the egg had been ſeparated. Purſuing his enquiries he found an egg in the ſuperior extremity of the other horn, and exactly like thoſe he had diſcovered in the right one. He ſays that the eggs which are ſeparated from the ovary are ten times ſmaller than thoſe which are faſtened to it; and he thinks that this difference is occaſioned from the eggs containing, when they are in the ovaries, another matter, and that is the glandular liquor he remarked in the molecules.

Four days after copulation he opened another, and found in one of the ovaries four, and in the other three follicules, emptied of their eggs; and in the horns correſponding to theſe he found an equal number of eggs. Theſe eggs were larger than the firſt that he found three days after copulation, and were about the ſize of a ſmall bird-ſhot; he alſo remarked that the internal membrane in theſe eggs was ſeparated from the external, and appeared like a ſecond egg in the firſt. In another, diſſected five days after copulation, he found five empty follicules in the ovaries, and as many eggs in the matrix, to which they adhered. Theſe eggs were about the ſize of a duck-ſhot, and the internal membrane was more apparent than in the one he had obſerved before. In one which he opened ſix days after copulation there were ſix empty follicules in one ovaria, and only five eggs in the correſponding horn, and they appeared in one maſs; in the other ovaria were four empty follicules and but one egg; theſe eggs were as big as ſwan-ſhot. He opened another on the ſeventh day after copulation, and found ſeven empty follicules; he alſo perceived ſeveral internal tumours in the matrix, from whence he took eggs the ſize of a piſtol bullet. Its membrane was more diſtinct than before, but contained only a very clear liquor. In one, eight days after copulation, he found in the matrix tumors, or cells, which contained the eggs, but they were very adherent, for he could not looſen them. In another, nine days after copulation, the cells, which contained the eggs, were greatly increaſed, and he ſaw that the liquor incloſed by the internal membrane had now got a light cloud floating upon it.

He opened another ten days after copulation and the cloud was thicker, and formed an oblong body, like a little worm. At laſt, on the twelfth day after copulation, the figure of the embryo was diſtinctly to be perceived, which two days before only preſented the figure of an oblong body; it was even ſo apparent that the different members might be diſtinguiſhed. In the region of the breaſt he perceived two red and two white ſpecks, and in the abdomen a mucilaginous ſubſtance, ſomewhat reddiſh. Fourteen days after copulation the head of the embryo was become large and tranſparent, the eyes prominent, the mouth open, the rudiments of the ears appeared; the backbone, of a whitiſh colour, was bent towards the breaſt, and ſmall blood-veſſels came from each ſide, whoſe ramifications ran along the back as far as the feet; the two red ſpecks, being conſiderably increaſed, appeared to be no other than the ventricles of the heart; by the ſides of theſe red ſpecks were two white ones, which were the rudiments of the lungs. In the abdomen the outlines of the liver were ſeen of a reddiſh colour, and a little intricate maſs, like a ravelled thread, which was the ſtomach and inteſtines. After this the proceſs was no more than a growth and expanſion of every part till the thirty-firſt day, when the female rabbit brings forth her young.

From theſe experiments De Graaf concludes, that all viviparous females have eggs; that theſe eggs are contained in the teſticles, called ovaries; that they cannot diſengage themſelves till they are impregnated, becauſe, he ſays, the glandular ſubſtance, by means of which the eggs quit their follicules, is not produced till after an impregnation. He alſo inſiſts, that thoſe who ſuppoſe they have ſeen eggs in only two or three days increaſed in ſize, muſt have been miſtaken, for theſe eggs remain a longer time in the ovary, although fecundated, and inſtead of immediately increaſing, they rather diminiſh until they are deſcended from the ovaries into the matrix.

By comparing theſe obſervations with thoſe of Harvey, we ſhall eaſily perceive that the principal circumſtances have eſcaped the latter; and although there are many errors in the reaſoning and experiments of De Graaf, nevertheleſs this anatomiſt, as well as Malpighius, has made better obſervations than Harvey. They agree in the principal points, and are both contrary to Harvey; the latter had never ſeen the alterations which happen to the ovary; he did not ſee the ſmall globules in the matrix which contain the apparatus of generation, and which De Graaf calls *eggs*. He had not even a ſuppoſition that the fœtus exiſted in this egg; and though his experiments give us nearly an exact account of what occurs during the growth of the fœtus, they give us no information either of the moment of fecundation or of the firſt developement. Schrader, a Dutch phyſician, who held Harvey in great veneration, owns that we muſt not put too great a reliance in that anatomiſt in many things, and eſpecially on what he ſays of the fecundative moment, for the chicken in fact is in the egg before incubation, and that Joſeph de Aromatarius was the firſt who obſerved it *. Although Harvey pretended that every animal proceeds from an egg, he did not imagine that the teſticles of females contained theſe eggs, and has only repeated what Ariſtotle has ſaid on this ſubject. The firſt who ſpeaks of having diſcovered eggs in female ovaries is Steno, who ſays, in diſſecting a female ſea-dog he ſaw eggs in the teſticles, although that animal is viviparous; and he adds, that the teſticles

---

* See Obſerv. Juſti Schraderi, Amſt. 1674.

ticles of women are analogous to the ovaries of oviparous animals, whether the eggs fall in any manner into the matrix, or whether there only falls the matter they contain. Although Steno is the firſt who diſcovered theſe pretended eggs, De Graaf claims the merit to himſelf, and Swammerdam has diſputed it with him, inſiſting that Van Horn had perceived theſe eggs before De Graaf. It is true this laſt writer ſtands charged with aſſerting many things experience has found to be falſe. He pretended that a judgment might be formed of the number of fœtuſes contained in the matrix by the number of cicatrices, or empty follicules, in the ovary, which is not true, as we may ſee by the obſervations of Verrheyen *, and by thoſe of M. Mery †, and by ſome of De Graaf's own obſervations, where he found fewer eggs in the matrix than cicatrices in the ovaries. Beſides, we ſhall make it appear that what he ſays concerning the ſeparation of the eggs, and the manner in which they deſcend into the matrix, is not exact; that no eggs exiſt in the female teſticles; that what is ſeen in the matrix is not an egg; and that nothing

---

* Vol. I. chap. iii. Bruſſels edit. 1710.

† Hiſt. of the Academ. 1701.

thing can be worſe founded than the ſyſtems endeavoured to be eſtabliſhed on the obſervations of this famous anatomiſt.

This pretended diſcovery of eggs in the teſticles of females attracted the attention of moſt anatomiſts; they, however, only met with ſmall bladders in the teſticles of female viviparous animals, theſe they did not heſitate to look on as real eggs: they therefore gave the name of *Ovaries* to the teſticles, and called the veſicles *Eggs*. They alſo ſaid, with De Graaf, that there are eggs of different ſizes in the ovarium; that the largeſt in the ovarium of women was not above the ſize of a ſmall pea; that they were very ſmall in the young, but increaſed with age and intercourſe with men; that twenty might be counted in each ovarium; that theſe eggs are fecundated in the ovarium by the ſpirited part of the ſeminal liquor of the male; that afterwards they looſen and fall into the matrix, where the fœtus is formed, from the internal ſubſtance of the egg and the placenta of the external matter; that the glandular ſubſtance, which does not exiſt in the ovarium till after a fruitful copulation, ſerves to compreſs the egg, and make it quit the ovarium, &c. But Malpighius having examined things more minutely, detected many of their errors before they were even received; yet moſt phyſicians adopted the ſentiments of De Graaf, without any attention to the obſervations of Malpighius; which, notwithſtanding, are very important, and to which his ſcholar Valiſnieri has given a great deal of weight.

Malpighius and Valiſnieri, of all naturaliſts, ſpeak with the greateſt foundation on the ſubject of generation. We ſhall therefore give an account of their experiments and remarks, to which we cannot pay too much attention.

Malpighius, having examined a great number of the teſticles of cows and other female animals, affirms that he found veſicles of different ſizes in the teſticles of all of them, whether young or adults; theſe veſicles are incloſed by a thick membrane, in the inner parts of which there are blood veſſels, filled with a kind of lymph, or liquor, which hardens by the heat of the fire like the white of an egg.

In time a firm yellow body grows which adheres to the teſticles. It is prominent and increaſes to the ſize of a cherry, occupying the greateſt part of the ovarium. The body is compoſed of many little angular tubes, and its poſition is irregular; it is covered with a coat, or membrane, ſpread over with nerves and blood veſſels. The appearance and form of this yellow body are not always the ſame, but vary according to time. When not above the ſize of a millet ſeed, it is nearly globular, and if divided appears compoſed of a kind of variegated net-work. Very often an external covering is obſerved, compoſed of the ſame ſubſtance as the yellow body, around the veſicles of the ovarium.

When the yellow body is become nearly of the ſize of a pea, it is the ſhape of a pear, in which is a ſmall cavity filled with liquor; as is alſo the caſe when grown to the ſize of a cherry.. In ſome of theſe yellow ſubſtances, when increaſed to their full maturity, Malpighius ſays, a ſmall egg with its appendages, not bigger than a millet ſeed may be ſeen near the centre; when they have caſt out their eggs they are empty, reſemble a cavernous paſſage, and the cavities which incloſe them are about the ſize of peas. He thinks this yellow and glandular ſubſtance nature produces to preſerve the egg, and aſſiſt it in leaving the teſticles, and perhaps to contribute towards the generation of the egg itſelf; conſequently, he ſays, the veſicles, which are always obſerved in the ovary, and which are of different ſizes, are not real eggs that may be fecundated, but only ſerve for the production of the yellow body where the egg is to be formed. On the whole, although theſe yellow ſubſtances are not found at all times in all teſticles, we nevertheleſs always find the firſt traces of them, and Malpighius having ſeen the marks of them in young heifers, cows that were with calf, and in pregnant women, he reaſonably concludes that this yellow and glandular ſubſtance is not, as De Graaf has ſuppoſed, the effect of fecundation, but what produces the infecund eggs, which leave the ovary without any communication with the male, as well as to thoſe which leave it after communication. When the latter falls into the tubes of the matrix, all the reſt is performed as De Graaf has deſcribed.

Theſe obſervations of Malpighius ſhew that the teſticles of females are not real ovaries, as moſt anatomiſts believe; that the veſicles they contain are not eggs; that theſe veſicles never fall into the matrix; and that the teſticles, like thoſe of the male, are kinds of reſervoirs, containing a liquor which muſt be looked upon as an imperfect ſeed of the female, that is perfected in the yellow glandular body which fills the internal cavity, and is ſhed when the glandular ſubſtance has acquired its full maturity. But before we decide on this important point, we muſt relate the obſervations of Valiſnieri ; and we ſhall perceive that, though Malpighius and Valiſnieri have made good obſervations, they have not carried them far enough, nor drawn thoſe conſequences from them which their obſervations might naturally have produced, becauſe they were both prejudiced for the ſyſtem of eggs, and of the fœtus pre-exiſting therein.

Valiſnieri began his experiments in 1692, on the teſticles of a ſow, whoſe teſticles are not compoſed like thoſe of a cow, ſheep, mare, bitch, female aſs, ſhe goat, nor moſt other viviparous females, for they reſemble a ſmall bunch of grapes, whoſe ſeeds are round and prominent outwardly. Between theſe ſeeds there are ſmaller, which have not arrived to maturity. Theſe ſeeds do not appear to be ſurrounded with one common membrane ; they are, he ſays, ſimilar to thoſe yellow ſubſtances which Malpighius obſerved in cows; they are round, of a reddiſh colour, their ſurface ſprinkled over with ſanguinary veſſels like the eggs of viviparous animals, and together form a maſs larger than the ovary; we may, with a little addreſs, and by dividing the membrane, ſeparate theſe grains one by one, and draw them from the ovary, where they each leave an impreſſion.

Theſe glandular ſubſtances are not of the ſame colour in every ſow, in ſome they are red, in others more clear; and they are of all ſizes, from the moſt minute point to that of a grape. On opening them we find a triangular cavity filled with a limpid liquor, which coagulates by the fire, and becomes white like that contained in the veſicles. Valiſnieri hoped to meet with the egg in one of thoſe cavities, but although he ſought for it with the utmoſt aſſiduity in the glandular ſubſtance of the ovaries of four different ſows, and afterwards in thoſe of other animals, yet he could never diſcover the egg which Malpighius aſſerts to have met with once or twice.

Below theſe glandular ſubſtances the veſicles of the ovary were ſeen, and which were in a greater or leſſer number as the glandular ſubſtances are thicker or ſmaller, for in proportion as the glandular ſubſtances increaſe the veſicles diminiſh. Some of theſe veſicles were the ſize of a lentil, and others as ſmall as a millet-ſeed. In crude teſticles twenty, thirty, or thirty-five veſicles might be counted, but when boiled a greater number are ſeen; and they are ſo ſtrongly connected by fibres and membraneous veſſels, that it is impoſſible to ſeparate them without a rupture.

Having examined the teſticles of a ſow which had never littered, he found there, as in the reſt, glandular bodies, and their triangular cavities filled with lymph, but never met with the egg either in the one or the other. The veſicles of this ſow which had never littered were greater in number than in thoſe which had littered or conceived. In the teſticles of another ſow which had conceived, and whoſe young were much expanded, he found two large glandular ſubſtances, that were empty, and others ſmaller, in their common ſtate. Having alſo diſſected many others when with young, he found that the number of glandular ſubſtances was always greater than that of the fœtus, which confirms our obſervations on De Graaf's experiments, and proves they are not exact; what he terms the follicules of the ovary being only the glandular ſubſtances, whoſe number always exceed that of the fœtus. In the ovaries of a ſow but a few months old, the teſticles were large, and ſprinkled with veſicles pretty well tumified, between theſe veſicles there were four riſing glandular ſubſtances in one of the teſticles, and more in the other.

After having finiſhed his experiments on ſows, Valiſnieri repeated thoſe of Malpighius on the teſticles of cows, and found that all he had ſaid was conformable to truth; only Valiſnieri owns that he has never been able to find the egg which Malpighius thought he had ſeen once or twice in the internal cavity of glandular bodies. Valiſnieri proceeded in his experiments upon a variety of other animals to diſcover this egg, but in vain; nevertheleſs his prejudice for that ſyſtem induced him, contrary to his experience, to admit the exiſtence of eggs, which neither he nor any other man ever did or ever will ſee. It is ſcarcely poſſible to make a greater number of experiments, or better than he has done. He obſerves, as ſomething particular to a ewe, that there are never more glandular ſubſtances in the teſticles than fœtuſſes in the matrix. In young ewes, which have never been with the male, there is but one glandular ſubſtance in each teſticle, which when worn away another is found; and if a ewe has only one fœtus in her matrix, there is but one glandular ſubſtance in the teſticles; if there are two fœtuſſes, there will be two glandular ſubſtances. This ſubſtance occupies the greateſt part of the teſticles; after it diſappears another is formed for the purpoſe of another generation.

In the teſticles of a ſhe-aſs he perceived veſicles the ſize of ſmall cherries, which evidently prove they are not eggs, ſince being of that ſize they could not enter into the horns of the matrix, which are too narrow in this animal for their reception.

The teſticles of a female dog, wolf, or fox, have a kind of cowl or covering, which is produced by the expanſion of the membrane that ſurrounds the horns of the matrix. In a bitch, whoſe heat was juſt began and had not been brought to a dog, Valiſnieri found this cowl, which is not adherent to the teſticle, internally bathed with a liquor like whey: he diſcovered alſo two glandular ſubſtances in the right teſticle, which run almoſt its whole extent. Theſe glandular ſubſtances had each a ſmall nipple, with a little orifice, from which of itſelf iſſued a clear liquor like whey, and when preſſed, a greater quantity came out, which made him imagine that this liquor was the ſame as, that found within the cowl: he blew into this orifice by the means of a ſmall pipe, and immediately the glandular body was puffed up; and having introduced a briſtle, he eaſily penetrated to the end of it: he opened this glandular ſubſtance the ſame way as the briſtle was entered, and found within a cavity which communicated with the orifice, and which alſo contained a good deal of liquor. Valiſnieri was alſo in hopes to diſcover the egg, but, notwithſtanding all his endeavours and ſtrict attention, he never could perceive it. He remarked, that the extremity of theſe nipples, from which this liquor flowed, was contracted by a ſphinctert which ſerved to ſhut up, or open the orifice of the nipple: he found alſo in the left teſticle two glandular bodies with the like cavities, nipples, orifices, and liquor diſtilling from them. Still not being able to find the egg, neither in this liquor, nor in the cavity which contained it, he boiled two of theſe glandular ſubſtances, hoping that by this means he might diſcover the object he was in purſuit of, but it was all in vain.

Having opened another bitch, eight or nine days after ſhe had been with the male, he found no difference in the teſticles; there were three glandular ſubſtances like the preceding ones, and, like them, diſtilled a liquor from the nipples. Here he alſo perſevered in his fruitleſs reſearches after the egg. By the help of a microſcope, he perceived the glandular ſubſtances were a kind of vaſcular net-work, formed by an infinite number of ſmall globular veſicles which ſerved to filter the liquor that iſſues through the end of the nipple.

After this he opened another bitch whoſe heat was off, and having introduced air between the teſticle and its covering, he found it dilated like a bladder by means of inflation; having raiſed this cowl, he found three glandular ſubſtances on the teſticle, but they had no apparent nipple nor orifice, nor did any liquor diſtil from them.

In another bitch that had pupped two months, and had five puppies, he found five glandular ſubſtances, which were become very ſmall, and began to obliterate, without leaving any cicatrices: there ſtill remained a ſmall cavity in the middle, but it was dry and empty.

Not content with theſe, and many more experiments, Valiſnieri, who would not give up his reſearches after the pretended egg, called together the moſt expert anatomiſts of his country, among whom was M. Morgagni, and having opened a young bitch at the time of her firſt heat, and had been with a male three days before, they examined the veſicles of the teſticles, the glandular ſubſtances with their nipples, orifice, and liquor which flowed from them, and in their internal cavities, but not an egg was to be found. After this he made experiments on female goats, foxes, cats, and a great number of mice, &c. He always found veſicles in the teſticles of all thoſe animals, and often the glandular ſubſtances, and the liquor they contained, but never any egg.

At length, deſirous of examining the teſticles of a woman, he had an opportunity of opening a farmer's wife, a young woman that was killed by a fall from a tree. She had been married ſeveral years, but although of a good habit of body, yet ſhe had never borne a child. He ſought if the cauſe of her ſterility was not diſcoverable in the teſticles ; and he found the veſicles all replete with a blackiſh and corrupted matter.

In the teſticles of a girl of eighteen, who had been brought up in a convent, and according to all appearances was a virgin he found the right teſticle ſomewhat larger than the left : its ſhape was oval, and its ſurface a little unequal. This inequality was produced by the protuberance of five or ſix veſicles of the teſticle which advanced forwards ; one of which was more prominent than any of the reſt. Having opened this veſicle, a ſpirit of lymph iſſued out: around it there was a glandular ſubſtance in form of a creſcent, of a yellowiſh colour rather bordering on the red. He cut the remainder part of the teſticle tranſverſely, and found many veſicles filled with a limpid liquor, and remarked that the correſponding trunk to this teſticle was very red and a little longer than the other, as he had frequently obſerved in female animals when in their amorous ſeaſon.

The left teſticle was as round as the right, it was whiter, and its ſurface more ſmooth ; for although there were ſome veſicles a little prominent, yet there were not any in form of a nipple ; they were all alike, without any glandular ſubſtance, and the correſponding trunk was neither inflamed nor red.

In a little girl of five years old he found the teſticles with the veſicles, blood veſſels, fibres, and nerves complete.

In the teſticles of a woman ſixty years of age he found ſome veſicles, and the veſtiges of a glandular ſubſtance, which were as ſo many thick points of matter of a dark browniſh colour.

From all theſe obſervations Valiſnieri concludes, that the buſineſs of generation is carried on in the female teſticles, which he looked upon as ovaries, although he never found any eggs in them, but, on the contrary, evidently ſaw that the veſicles were not eggs. He alſo ſays, that it is not neceſſary for the ſeed of the male to enter into the matrix to impregnate the egg: he ſuppoſes that the egg comes from the nipple of the glandular ſubſtance, after impregnation in the ovarium; that from thence it falls into the trunk, and deſcends by degrees till at laſt it faſtens to the matrix. He adds, he is perſuaded that the egg is concealed in the glandular ſubſtance, and that all the buſineſs of generation is performed in the cavity, although neither he nor any other anatomiſt have ever ſeen or been able to find it.

According to Valiſnieri the ſpirit of the male ſeed aſcends to the ovarium, forces its way into the egg, and gives motion to the fœtus that pre-exiſts therein. In the ovarium of the firſt woman were eggs, which not only incloſed in miniature every child ſhe brought forth, but of the whole human race. That if we cannot conceive this infinite chain of individuals contained in one it is the fault of our minds, the weakneſs of which is every day perceptible; but it is upon that account no leſs true, that every animal which has been, is, and will be, were created all at one time, and incloſed in the firſt females. The reſemblance of children to parents only proceeds, continues he, from the imagination of the mother, the power of which is ſo great on the fœtus that it can produce on it ſpots, marks, diſproportions, and extraordinary births, as well as perfect reſemblances.

This ſyſtem of the eggs, which is unreaſonable, and without foundation, would nevertheleſs have obtained the unanimous ſuffrages of all phyſicians, if, when it was firſt endeavoured to be eſtabliſhed, another ſyſtem had not been formed on the diſcovery of ſpermatic animals.

This diſcovery, for which we are indebted to Leeuwenhoeck and Hartſoeker, has been confirmed by Andri, Valiſnieri, Bourguet, and many other obſervers of Nature. I ſhall relate what has been ſaid concerning the ſpermatic animals which are found in the ſeminal liquor of all males: they are in ſuch vaſt numbers that the ſemen ſeems to be entirely compoſed of them; and Leeuwenhoeck pretends to have ſeen many millions of them in a drop ſmaller than the ſmalleſt grain of ſand. Although we do not meet with any in female animals they abound in all males, both in the ſemen emitted naturally and that in the teſticles, as well as in the ſeminal veſicles. If the ſemen of a man is expoſed to a moderate heat it thickens, and the motions of all the animalcules immediately ceaſe; but if allowed to cool it becomes thinner, and the animals preſerve their motion till the liquor thickens as it dries away. The thinner the liquor becomes the more the animalculæ increaſe, and if water is added it will appear like a ſubſtance of ſmall animals. When the motion of theſe animalculæ is nearly finiſhed, whether from heat, or any other cauſe, they ſeem to aſſemble cloſer together, and have a whirling motion in the centre of the ſmall drop which may have been taken out for obſervation, and appear all to periſh at one and the ſame time, whereas in the larger portion of the liquor they are eaſily ſeen to periſh ſucceſſively.

The animalculæ, ſay they, have different figures in different animals; nevertheleſs they are all long, ſlender, without any appearance of limbs, and move with rapidity. The fluid which contains them, as we have already obſerved, is heavier than blood. The ſemen of a bull afforded Verrheyen, by a chemical proceſs, firſt phlegm, afterwards a conſiderable quantity of fœtid oil, but little volatile ſalt, and much more earth than he could have thought*. This author appears ſurpriſed that in rectifying the diſtilled liquor he could not draw any ſpirit from it, and being perſuaded it contained a great quantity he attributed the evaporation to its great ſubtility: but may it not be more reaſonably imagined that it contains very little or no ſpirits, as neither its conſiſtency nor ſmell announce any ardent ſpirit, and which is only plentifully found in fermented liquors? beſides, with

---

* See Veerheyen, ſup. anat. tom ii. page 69.

with reſpect to volatile ſpirits, the horns, bones, and other ſolid parts of animals afford more than all the liquor of the animal body. What anatomiſts have called animal ſpirits, *aura ſeminalis*, may poſſibly not exiſt; and it is certainly not theſe ſpirits which agitate the particles ſeen moving in the ſeminal liquors; but we will here relate the principal obſervations that has been made on this ſubject.

Leeuwenhoeck obſerved, in the ſemen of a cock, animals which reſembled the figure of an eel, but ſo exceedingly minute that he pretends fifty thouſand would not equal in ſize a grain of ſand; and in that of a rat many millions would be required to make the thickneſs of a hair, &c. This obſerver imagined that the whole ſubſtance of the ſemen was only a maſs of theſe animalcules. He perceived theſe animalculæ in the ſemen of men, quadrupeds, birds, fiſhes, inſects, &c. In that of graſshoppers they were long and ſlender. They are attached, he ſays, by their extremities, and the inferior of which he calls the tail, had a quick motion, like that of the tail of a ſerpent, when the upper part is motionleſs. He further adds, that in the ſemen of young animals the animalculæ are motionleſs, but as the age for reproduction comes on they move about with great vivacity.

In the ſemen of a male frog he obſerved animalculæ, at firſt they were imperfect and motionleſs, but ſome time afterwards he found them living: they were ſo very ſmall, he ſays, that ten thouſand would ſcarcely equal the ſize of a ſingle egg of the female. It was only thoſe in the ſeminal liquor of the frog which had life and motion.

In the ſemen of a man, and that of a dog, he pretends to have ſeen two kinds, which he looked upon as males and females. Having incloſed the ſeed of a dog in a vial, he ſays, that numbers of the animalculæ died the firſt day; the ſecond and third there died ſtill more, and very few remained alive the fourth. But having repeated this experiment on the ſemen of the ſame dog, he found, at the end of ſeven days, live animalculæ, ſome of which ſwam with as much ſwiftneſs as in freſh-extracted ſemen; and having opened a bitch which had been three times with the ſame dog, he could not perceive by the naked eye any ſeminal liquor of the male in either of the horns of the matrix; but by help of a microſcope he diſcovered the ſpermatic animals of the dog in both horns of the matrix, and great numbers of them in that part of the matrix adjoining to the vagina, which, ſays he, evidently proves that the male ſemen enters the matrix, or at leaſt that the ſpermatic animals of the dog had got there by their own motion, which is ſufficient to carry them four or five inches in half an hour. In the matrix of a doe rabbit, which had juſt received the buck, he likewiſe obſerved an infinite number of ſpermatic animals; he ſays, that their bodies are round, with long tails, and that they often change their forms, eſpecially when the humid matter in which they ſwim evaporates and dries.

Leeuwenhoeck's experiments have been frequently repeated and found conformable to truth. There have been ſome inclined to exceed him in theſe diſcoveries. Dr. Dalenpatius having obſerved the ſeminal liquor of a man, not only pretended to have diſcovered animals like tadpoles, whoſe bodies appeared nearly the ſize of a grain of wheat, and their tails four or five times longer than their bodies, and which moved with great agility, but what is ſtill more marvellous, he obſerved one of theſe animals quit its covering; upon which it was no longer an animalcule, but had become a human a human body, the two legs of which, he affirms, were very diſcernible, as were the arms, breaſt, and head*. But by the figures which this author has given of this pretended embryo, it is evident his aſſertion is falſe. He might ſuppoſe he ſaw what he relates, but he was miſtaken; for the embryo, ſuch as he deſcribes, was more formed on quitting this covering, and the ſtate of a ſpermatic worm, than it would have been at the end of a month or five weeks in the matrix of its mother; therefore this obſervation of Dalenpatius, inſtead of having been confirmed by other obſervations, has been rejected by every naturaliſt, the moſt exact and accurate of which have only diſcovered, in the ſeminal liquor of man, round and oblong bodies, which ſeemed to have long tails, but without any kind of members.

It might be ſaid that Plato had ſpoken of theſe ſpermatic animals which become human forms; for he ſays, " Vulva quoque matrix que in fœminis eadem ratione animal avidem generandi, quando procul a fœtu per ætatis florem, aut ultra diutius detinetur, ægre fert moram ac plurimum indignatur, paſſimque per corpus oberrans, meatus ſpiritus intercludit, reſpirare non ſinit, extremis vexat anguſtiis, morbis denique omnibus premit, quoſque utrorumque Cupido amorque quaſi ex arboribus fœtum fructumve producunt, ipſum deinde decerpunt, & in matricem velut agrem inſpargunt; hinc animalia primum talia, ut nec propter parvitatem videantur, necdum appareant formata, concipiunt: mox quæ conflaverant, explicant, ingentia, intus enutriunt, demum educunt in lucem, animaliumque generationem perficiunt." Hippocrates, in his treatiſe *De Diæta*, ſeems alſo to inſinuate, that the ſeed of animals is replete with animalcules. Democritus ſpeaks of certain worms which take the human figure, and Ariſtotle ſays, that the firſt men came out of the earth in the form of worms; but neither the authority of Plato, Hippocrates, Democritus, Ariſtotle, nor the obſervation of Dalenpatius, can make us receive the idea that theſe ſpermatic worms are ſmall human bodies, concealed under a covering; for it is evidently contrary to experience and obſervation.

---

* See Nouvelles de la Republique des Lettres. Ann. 1699, page 552.

Valiſnieri and Bourguet, whom we have quoted, diſcovered ſmall worms in the ſeed of a rabbit, a rabbit, one of whoſe extremities was thicker than the other; they were very lively and active, ſtruck the liquor with their tails, and twiſted and turned themſelves like ſnakes. At laſt (ſays Valiſnieri) I clearly perceived them to be real animals, "e gli riconobbi, e gli giudicai ſenza dubitamento alcuno per veri, veriſſimi, arciveriſſimi vermi *." This author, who was prejudiced with the ſyſtem of eggs, has, nevertheleſs, admitted of ſpermatic worms, and taken them for real animals.

M. Andry having made obſervations on theſe ſpermatic worms of a man, pretends, that they are only found in the age proper for generation; that in the younger years, and in old age, they do not exiſt: that in thoſe affected with venereal diſorders there are very few, and thoſe are languiſhing, and for the moſt part dead: that in impotent perſons we do not ſee any alive; that theſe worms in the ſemen of men have larger heads than in that of other animals, which agrees, he ſays, with the figure of the fœtus and the child; and he adds, that thoſe people who too frequently enjoy female amours, have generally but few or none of theſe animalcules in their ſemen.

Leeuwenhoeck,

---

* Opere dell. Cav. Valiſnieri, vol. II. page 105.

Leeuwenhoeck, Andry, and many others, ſtrenuouſly oppoſed the egg ſyſtem ; they had diſcovered in the ſemen of all males living animalcules ; they proved that theſe animalcules could not be regarded merely as dwelling in this liquor, ſince their bulk was greater than that of the liquor itſelf ; and that nothing like them was found either in the blood, or in the other animal liquors. They aſſerted, that females furniſhed nothing ſimilar, nothing alive ; and it was therefore evident that the fecundity attributed to them belonged, on the contrary, to males alone : and that the diſcovery of theſe ſpermatic animals in the ſemen tended more to the explanation of generation than all that had been before ſuppoſed ; ſince, in fact, what was moſt difficult to conceive in generation, was the production of the living part, all the reſt being only acceſſary operations, and therefore no doubt could remain but theſe little animals were deſtined to become men, or perfect animals of their kind. When it was oppoſed to the partizans of this ſyſtem, that it did not ſeem natural to ſuppoſe that ſo many millions of animalcules, every one of which might become a human being, ſhould be employed for a purpoſe of which one alone was to reap the advantage ;

advantage; when it was aſked them, why this uſeleſs profuſion of the ſhoots of human beings? they anſwered, that it was only conſonant with the common munificence of nature: that out of many millions of ſeeds which plants and trees produce, but a very few ſucceed, and therefore we muſt not be ſurpriſed at the ſame circumſtance in ſpermatic animals. When the infinite minuteneſs of the ſpermatic worm, compared to man, was objected to them, they anſwered, by the example of the ſeed of trees; and they added, with ſome foundation, metaphyſical reaſonings, by which they proved that great and ſmall being only relations, the tranſition from ſmall to great, or from great to ſmall was executed by nature with ſtill more facility than we can conceive.

Beſides, continue they, have we not very frequent examples of transformation in inſects? do we not ſee ſmall aquatic worms become winged animals, by only throwing off their coats, which were their apparent and external forms? and may not ſpermatic animals, by a ſimilar transformation, become perfect animals? All therefore, they conclude, concurs to favour this ſyſtem of generation, and confuting that founded on eggs; and if there are eggs in viviparous females, the ſame as in the oviparous, theſe eggs will only be the neceſſary matter for the growth of the ſpermatic worm, which enters into the egg by the pedicle that adheres to the ovarium, and where it meets with food ready prepared for it. All the worms which find not this paſſage through the pedicle into the egg will periſh, and that one which alone has traced its way will arrive at its transformation. The difficulty of meeting with the paſſage in the pedicle of the egg, can only be compenſated by the infinite number of ſpermatic worms. It is a million to one that any particular ſpermatic worm will meet with the pedicle of the egg, and therefore what at firſt appears a profuſion is highly neceſſary. When one has entered, no other can introduce itſelf, becauſe, ſay they, the firſt worm entirely ſhuts up the paſſage, or there is a valve at the entrance of the pedicle, which is free when the egg is not abſolutely full; but when the worm has filled the egg, the valve can no longer open although impelled by another worm. This valve is very well imagined, becauſe, if the firſt worm ſhould chance to return, it oppoſes its egreſs, and obliges it to remain and undergo the transformation. The ſpermatic worm then becomes the fœtus, the ſubſtance of the egg its food, the membranes, its covering, and when the nutriment in the egg is nearly exhauſted, the fœtus adheres to the internal ſkin of the matrix, and thus derives nouriſhment from the parent's blood, till by its weight, and augmentation of its ſtrength, it breaks through its impriſonment and comes perfect into the world.

By this ſyſtem it was not the firſt woman who incloſed all mankind, but the firſt man who contained all poſterity in his body. The pre-exiſting germs are no longer embryos without light, incloſed in the eggs, and contained one in another, ad infinitum; but they are ſmall animals, the little homunculæ organized and actually living, included in each other in endleſs ſucceſſion, and to which nothing is wanting for them to become perfect animals, and human beings, but expanſion, aſſiſted by a transformation ſimilar to that which winged inſects undergo.

As our preſent phyſicians are divided on theſe two ſyſtems of ſpermatic worms and eggs and as all thoſe who have lately written on generation have adopted one or the other of theſe opinions, it ſeems neceſſary to examine them with care, and to ſhew that they are not only inſufficient

cient to explain the phenomena of generation, but are alſo founded on ſuppoſitions void of all probability.

Both ſuppoſe an infinite progreſſion ; which, as we have ſaid, is not ſo much a reaſonable ſuppoſition as an illuſion of the mind. A ſpermatic worm is more than a thouſand million times ſmaller than a man ; if, therefore, we ſuppoſe the body of a man as an unit, the ſize of the ſpermatic worm can only be expreſſed by the fraction $\frac{1}{1000000000}$; and as man is with reſpect to the ſpermatic worm of the firſt generation, what this worm is to that of the ſecond generation, the ſize of the laſt ſpermatic worm cannot be expreſſed but by a number compoſed of nineteen cyphers ; and ſo likewiſe the ſize of the ſpermatic worm of the third generation will require 28 cyphers ; that of the fourth generation 37 ; the fifth 46, and the ſixth 55 cyphers. To form an idea of the minuteneſs repreſented by this fraction, let us take the dimenſions of the ſphere of the univerſe from Sol to Saturn, and ſuppoſing the ſun a million times larger than the earth, and about a thouſand ſolar diameters diſtant from Saturn, we ſhall perceive that only 45 cyphers are required to expreſs the number of cubic lines contained in this ſphere; and, by reducing each cubic line into a thouſand millions of atoms, 54 cyphers are only required to expreſs that number; conſequently a human being will be greater, with relation to a ſpermatic worm of the ſixth generation, than the ſphere of the univerſe is with relation to the ſmalleſt atom which is poſſible to be perceived by the aſſiſtance of a microſcope. What would it be if we were to carry it to ten generations? The minuteneſs would be ſo great as to leave us no mode of expreſſing it. The probability of this opinion, therefore, evidently diſappears in proportion as the object diminiſhes. This calculation may be applied to eggs as well as ſpermatic worms, and the want of probability is general to both; it will, no doubt, be ſaid, that matter being diviſible, *ad infinitum*, there is no impoſſibility in this diminution of ſize; and although it is not probable, yet we muſt regard this diviſion of matter as poſſible, ſince we can always, by thought, divide an atom into a number of parts. But I anſwer, that the ſame illuſion is made uſe of on this infinite diviſibility as on every other geometrical and arithmetical infinity; they are only abſtractions of the mind, and have no exiſtence in nature.

If we look on infinite diviſibility of matter as an abſolute infinity, it is eaſy to demonſtrate that in that ſenſe it does not exiſt; for, if once we ſuppoſe the ſmalleſt atom poſſible, by that ſuppoſition this atom will neceſſarily be indiviſible, ſince if it were diviſible it would no longer be the ſmalleſt atom poſſible, which would be contrary to the ſuppoſition. It therefore ſeems to me, that every hypotheſis where a progreſs, *ad infinitum*, is admitted, ought to be rejected not only as falſe, but as void of all probability; and as the ſyſtem of eggs and ſpermatic worms ſuppoſes this progreſs, they ſhould not be admitted in philoſophy.

Another great difficulty againſt theſe two ſyſtems is, that in the egg ſyſtem the firſt woman contained the male and female eggs: the male eggs contained only a generation of males; and that, on the contrary, the female eggs contained thouſands of generations, both of males and females; inſomuch that, at the ſame time, and in the ſame woman, there was always a certain number of eggs capable of developing themſelves to infinity, and another number which would be unfolded but once. The ſame circumſtance muſt occur in the other ſyſtem, and therefore I aſk if there is the ſmalleſt appearance of probability in theſe ſuppoſitions?

A third difficulty ariſes againſt theſe two ſyſtems, which is, the reſemblance that children bear, ſometimes to the father and ſometimes to the mother, and ſometimes to both; and the evident marks of extraordinary difference in mules, &c. If from the ſpermatic worm of the father the fœtus is produced, how can the child reſemble the mother? and if the fœtus is pre-exiſting in the egg of the mother, how can the child reſemble its father? or if the ſpermatic worm of an horſe, or the egg of a ſhe-aſs contains the fœtus, how can the mule participate in the nature and figure of both the horſe and the aſs.

Theſe general difficulties, which are invincible, are not the only ones that can be made againſt theſe ſyſtems; there are particular ones which are no leſs potent. To begin with the ſyſtem of ſpermatic worms, may it not be aſked of thoſe who admit of it, how they think this transformation is made? and object to them, that inſects have not, nor cannot have any relation with what they ſuppoſe. For the worm which is to become a fly, or the caterpillar which is to become a butterfly, paſſes through a middle a middle ſtate, and when it ceaſes to be a chryſalis, it is completely formed and has acquired its full ſize, and is then in a condition of engendering; whereas in the pretended transformation of the ſpermatic worm into man, it cannot be ſaid to be in a ſtate of chryſalis, and even if we ſhould ſuppoſe one during the firſt days of conception, why does not the production of this chryſalis, inſtead of an unformed embryo, ſuppoſe an adult and perfect being? we plainly ſee how analogy is here violated? and that far from confirming this idea of the transformation of the ſpermatic worm, it is inſtantly deſtroyed by examination.

Beſides, the worm which is transformed into a fly proceeds from an egg; the egg is the produce of the copulation of the male and female, and includes the fœtus, which muſt afterwards enter into a chryſalis, before it arrives at its ſtate of perfection, as a fly; in which form alone it has an engendering power; whereas the ſpermatic worm has no faculty of generation, nor proceeds from an egg. Even ſhould we allow the ſemen to contain eggs, from whence iſſue ſpermatic worms, the ſame difficulty will ſtill remain, for theſe ſuppoſed eggs have not the copulation of the two ſexes for their principle of exiſtence, as in inſects; conſequently the partizans of that opinion cannot pretend any ſimilarity, nor derive any advantage from the transformation of inſects; which rather deſtroys the baſis of their explanation.

When the innumerable multitude of ſpermatic worms are oppoſed to thoſe phyſicians who are prejudiced with this ſyſtem, they anſwer, as before obſerved, by the examples of plants and trees. But this compariſon is not entirely juſt, becauſe all the ſpermatic worms excepting one periſh by abſolute neceſſity, which is not the caſe with the ſeeds of a tree or plant, for thoſe which do not become vegetables, ſerve as food for other organized bodies, and for the expanſion and reproduction of animals; whereas we do not ſee any uſe for the ſpermatic worms, or any end to which we can refer their prodigious ſuperfluity. On the whole, I only make this remark in reply to what is, or may be ſaid on this matter; for I own, that no arguments drawn from final cauſes will either eſtabliſh or deſtroy a phyſical ſyſtem.

Another objection made againſt this opinion is, there being, to all appearance, an equal number of ſeparate worms in the ſeed of all kinds of animals, for, ſay they, it is natural to imagine, that in thoſe kinds where fœtuſſes are moſt abundant, as in fiſhes, inſects, &c. the number of ſpermatic worms ſhould be more numerous than in thoſe where generation is leaſt abundant, as in man, quadrupeds, birds, &c. for if they are the immediate cauſe of production, why is there no proportion between their number and that of the fœtus? Beſides, there is no proportionable difference in the ſize of moſt kinds of ſpermatic worms, thoſe of large animals being as ſmall as thoſe of the leaſt. Thoſe of a rat, and thoſe of a man, are nearly the ſame, and when there is any difference it is no ways relative to the ſize of the individual. The Calmar, which is a very ſmall fiſh, has ſpermatic worms above one hundred thouſand times larger than thoſe of a man or a dog. Another proof theſe worms are not the immediate and only cauſe of generation.

The particular difficulties that may be raiſed againſt this egg ſyſtem are no leſs conſiderable. If the fœtus exiſts in the egg before the communication of the male with the female, why do we not perceive the fœtus as well in thoſe eggs produced before as after copulation? We have before recounted the obſervations of Malpighius, who ſays he always found the fœtus in thoſe eggs produced by hens that had received the cock, and only a maſs or mole in the cicatrice of thoſe who had not; it is therefore very clear that the fœtus does not exiſt in the egg till after impregnation.

Another difficulty againſt this ſyſtem is, that not only the fœtus is not ſeen in eggs before the junction of the ſexes, but even the exiſtence of eggs in viviparous animals is by no means proved. Thoſe phyſicians who pretend that the ſpermatic worm is the fœtus enveloped in a covering, are at leaſt aſſured of ſpermatic worms; but thoſe who affirm that the fœtus is pre-exiſting in the egg, have no proof of the exiſtence of the egg itſelf; on the contrary, there is a probability, almoſt equivalent to a certainty, that theſe eggs do not exiſt.

Although the partizans of the egg ſyſtem do not agree what muſt be looked on as the true egg in the female teſticle, nevertheleſs they all think that impregnation is made in the teſticle called the *ovarium*, without paying any attention that if it was ſo moſt fœtuſſes would be found in the abdomen inſtead of the matrix, for the ſuperior extremity of the trunk being ſeparated from the ovarium, the pretended eggs muſt often fall into the abdomen. Now, it is certain that this caſe is extremely rare, and, I believe, never happened, unleſs occaſioned by ſome accident.

The general difficulties and objections againſt theſe two ſyſtems have been noticed by the author of *Venus Phyſique*, whoſe treatiſe, although very ſhort, has more philoſophical ideas than there are in many folio volumes on generation. As this book is very public, and the accuracy with which it is written will not permit any extract, I ſhall only obſerve, this author is the firſt who has returned into the road of truth, from which we were farther ſtrayed than ever, ſince the ſuppoſition of the egg ſyſtem, and the diſcovery of ſpermatic animals. Nothing, therefore, remains farther to be ſaid, and I ſhall conclude with relating a few particular experiments, ſome of which have appeared favourable, and others contrary, to theſe ſyſtems.

In the Hiſtory of the Academy of Sciences of Paris, 1701, ſome objections are propoſed by M. Mery againſt the egg ſyſtem. This able anatomiſt ſupports, with reaſon, that the veſicles found in the female teſticles are not eggs, but are ſo adherent to the internal ſubſtance of the teſticle that they cannot be naturally ſeparated therefrom; that if they could ſeparate themſelves from this ſubſtance it would be impoſſible for them to get out, becauſe the common membrane, which ſurrounds all the teſticle, is a web of too firm a texture to admit of a conception; that a veſicle, or round ſoft egg, could open a paſſage in it; and as the greateſt number of phyſicians and anatomiſts were prejudiced in favour of the egg ſyſtem, and, from the experiments of De Graaf, believed that the number of cicatrices in the teſticles marked the number of fœtuſſes, M. Mery mentions the teſticles of a woman, where there was ſuch a quantity of theſe cicatrices, that, agreeable to this ſyſtem, would have ſuppoſed a fecundity almoſt beyond imagination. Theſe difficulties excited other partizans of the egg ſyſtem to make new reſearches. M. Duverney examined and diſſected the teſticles of cows and ſheep: he pretended that the veſicles were eggs, becauſe there were ſome leſs adherent to the teſticles than others, and inſiſted it was natural to believe, that when they came to perfect maturity they were ſeparated altogether, eſpecially as by inflating the internal cavity of the teſticle the air paſſed between theſe veſicles and the adjoining parts. M. Mery only anſwers that this is not a ſufficient proof, ſince theſe veſicles have never been ſeen ſeparate from the teſticles. M. Duverney remarked the glandular bodies on the teſticles, but he did not look on them as an eſſential and neceſſary part towards generation, but merely as accidental exuberances, like gall-nuts on the oak. M. Littre, whoſe prejudice for the egg ſyſtem was ſtill greater, pretended, not only that the veſicles were eggs, but even aſſerted he had diſcovered in one of them a well-formed fœtus, of which he diſtinguiſhed the head and trunk very perfectly, and even gave the dimenſions. But beſides this wonder being only ſeen by that gentleman, and no other naturaliſt, it is ſufficient to read his Memoire * to perceive how doubtful was the fact. By his own words we find the matrix was ſchirrhous, that the teſticle was corrupted, and that the veſicle, or egg, which contained this imaginary fœtus was ſmaller than the other veſicles, or eggs, which did not contain any thing, &c..

A famous

---

* Anno 1701, page 3.

A famous experiment, in favour of the egg ſyſtem, is ſupplied by De Nuck; he opened a bitch three days after copulation; he drew out one of the horns of the matrix, and made a ligature in the middle, ſo that the upper part of the paſſage could have no communication with the lower; after which he replaced this horn, and cloſed up the wound, with which the bitch ſeemed but little incommoded. At the end of twenty-one days he opened it again, and found two fœtuſſes in the upper part, that is between the teſticles and the ligature; but in the lower part there was no fœtus. In the other horn of the matrix, which had not been tied by a ligature, he found three fœtuſſes, which were regularly diſpoſed, which proves, he ſays, that the fœtus does not proceed from the ſeed of the male, but exiſts in the female egg. Suppoſing this experiment, which has only been made once, was always followed with the ſame effect, we ſhould not then be right in concluding that fecundation is made in the ovary, and that eggs are detached therefrom which contain the fœtus completely formed. It would only prove that the fœtus may be formed in the upper parts of the horns of the matrix as well as in the lower; and it ſeems very natural to imagine that the ligature, compreſſing the middle of the horns of the matrix, impelled the ſeminal liquors, which are in the lower parts, to iſſue out, and thus deſtroy the buſineſs of generation in them.

Thus we have gone through the opinions of anatomiſts and phyſicians on the ſubject of generation; and it now only remains for me to recount what I have been enabled to draw from my own reſearches and experiments, and it will then be ſeen whether my ſyſtem is not infinitely more agreeable to Nature than any of thoſe I have given an account of.

CHAPTER VI.

EXPERIMENTS ON THE METHOD OF GENERATION.

I OFTEN reflected on the above ſyſtem, and was every day more and more convinced that my theory was infinitely the moſt probable. I then began to ſuppoſe that, by a microſcope, I might be able to attain a diſcovery of the living organic particles, from which I thought every animal and vegetable drew their origin. My firſt ſuppoſition was, that the ſpermatic animalcules ſeen in the ſeed of every male, might poſſibly be theſe organic particles; on which I reaſoned as follows:

If every animal and vegetable contain a quantity of living organic particles, theſe particles

ticles would be found in their ſeed, and in a greater quantity than in any other ſubſtance, becauſe the ſeed is an extract of what is moſt analogous to the individual, and the moſt organic; and the animalcule we ſee in the ſeed of males are, perhaps, only theſe ſame living organic molecules, or at leaſt the firſt union, or aſſemblage of them. But if this is ſo, the ſeed of the female muſt alſo contain ſimilar living organic molecules, and, conſequently, we ought to find moving bodies there as well as in the male: and ſince the living organic particles are common both to animals and vegetables, we ſhould alſo find them in the ſeeds of plants, in the nectarium, and in the ſtamina, which are the moſt eſſential parts of vegetables, and which contain the organic molecules neceſſary for reproduction. I then ſeriouſly thought of examining the ſeminal liquors of both ſexes, and the germs of plants, with a microſcope. I thought, likewiſe, that the reſervoirs of the female ſeed might poſſibly be the cavities of the glandular bodies, in which Valiſnieri and others had uſeleſsly ſought for the egg; and at length determined to undertake a courſe of obſervations and experiments. I firſt communicated my ideas to Mr. Needham,

ham, a gentleman well known for his microſcopical obſervations, and read to him the firſt part of this work, he ſeemed to approve of theſe ideas, and did me the favour to lend me his microſcope, which was infinitely ſuperior to my own. At the ſame time I communicated my ſyſtem and project of experiments to Meſſrs. Daubenton, Gueneau, and Dalibard, all of whom encouraged me to perſevere in my determination, and from whom in the courſe of making thoſe experiments, I received much aſſiſtance, particularly from Mr. Daubenton.

Perſons not experienced in the uſe of the microſcope will not be diſpleaſed that I here inſert ſome remarks which will be uſeful to them, if they repeat the following experiments, or make new ones. We ſhould give the preference to double microſcopes, in which we ſee objects perpendicularly, from their having a plain or concave mirror which ſhews the objects clear; the concave mirror is the moſt preferable when the obſervations are made with the ſtrongeſt lens. Leeuwenhoek, who undoubtedly has been the greateſt and moſt indefatigable of all microſcopical obſervators, is ſaid to have only made uſe of ſimple microſcopes, with which he

viewed

viewed objects horizontally. If this is true, it is neceſſary to remark, that moſt of the plates given by Leeuwenhoek of microſcopical objects, eſpecially ſpermatic animals, repreſents them much thicker and longer than he really ſaw them, which renders the microſcopes we ſpeak of preferable to the horizontal, as they are more ſtable; the motion of the hand, with which the microſcope is held, producing a little trembling, which cauſes the object to appear wavering, and never preſents the ſame part for any time. Beſides there is always a motion in the liquors cauſed by the agitation of the external air, at leaſt, if we do not put the liquor between two plates of glaſs, or very fine talc, which diminiſhes ſomewhat of its tranſparency, and greatly lengthens the experiment; but the horizontal microſcope, whoſe tables are vertical, has the ſtill greater inconvenience, that the moſt ponderous parts of the drop of liquor falls to the bottom; conſequently there are three motions, that of the trembling of the hand, the agitation of the fluid by the action of the air, and alſo that of the parts of the liquor falling to the bottom: from the combination of which, certain ſmall globules which we ſee in theſe liquors,

quors, may appear to move by their own motion and powers, while they only obey the compounded power of thoſe three cauſes.

When we put a drop of liquor on the table of the double microſcope, although horizontally placed, and in the moſt advantageous ſituation, we ſtill ſee one common motion in the liquor which forces all what it contains to one ſide. We muſt wait till the fluid is in an equilibrium and at reſt, before we make our obſervations; for it often occurs, that this motion of the fluid hurries away many globules, and forms a kind of whirling motion which returns one of theſe globules in a very different direction to the others. The eye is then fixed on the globules, and ſeeing one take a different courſe from the reſt, ſuppoſes it an animal, or at leaſt a body, which moves of itſelf, whereas its motion is only owing to that of the fluid; and as the liquor is apt to dry and thicken in the circumference of the drop, endeavours muſt be made to fix the lens on the centre of it. The drop ſhould alſo be as large as poſſible, and contain as much liquor as will permit a ſufficient tranſparency, to ſee perfectly what it contains.

Before we begin to make obſervations, we ſhould have a perfect knowledge of our microſcope. There is no glaſs whatſoever but in which there are ſome ſpots, bubbles, threads, and other defects, which ſhould be nicely inſpected, in order that ſuch appearances ſhould not be repreſented as real and unknown objects: we muſt alſo endeavour to learn what effect the imperceptible duſt has which adheres to the glaſſes of the microſcope; a perfect knowledge of which may be acquired by obſerving the microſcope ſeveral times.

To make proper obſervations, the ſight, or focus, of the microſcope muſt not preciſely fall on the ſurface of the liquor, but a little above it; as not ſo much reliance ſhould be placed on what paſſes upon the ſurface, as what is ſeen in the body of the liquor. There are often bubbles on the ſurface which have irregular motions produced by the contact of the air.

We can ſee much better with the light of two ſhort candles, than in the brighteſt day, provided this light is not agitated, which is avoided by putting a ſmall ſhade on the table, incloſing the three ſides of the lights and the microſcope.

It will often appear as though dark and opaque bodies become tranſparent, and even take different colours, or form concentrical and coloured rings, or a kind of rainbow on their ſurface; and other matters, which are ſeen at firſt ſight tranſparent and clouded, become black and obſcure; theſe changes are not real, but only depend on the obliquity the ſight falls on the body with, and the height of the plain in which they are found.

When there are bodies in a liquor which ſeem to move with great ſwiftneſs, eſpecially when they are on the ſurface, they form a furrowed motion in the liquor, which appears to follow the moving body, and which we might be inclined to miſtake for a tail. This appearance deceived me at firſt, but I clearly perceived my error, when theſe little bodies met others which ſtopped them; for there was no longer any appearance of tails. Theſe are the remarks which occurred during my experiments, and which I ſubmit to thoſe who would make uſe of the microſcope for the obſervation of liquors.

EXPERIMENTS.

I. I took from the ſeminal veſſels of a man, who died a violent death, and whoſe body was ſtill warm, all the liquor therein contained, and put it into a ſmall bottle; of this I put a drop on the table of a microſcope, without the addition of water or any other liquor. The firſt thing which preſented, was a vapour which ſteamed from the liquor towards the lens, and obſcured it. Theſe vapours being diſſipated, I perceived large filaments, (*fig.* 1.) which in ſome places ſeemed to extend into different brancnes, and in others to intermingle together. Theſe filaments clearly appeared to be internally agitated by an undulating motion, and looked like hollow tubes which contained ſome moving ſubſtance. I diſtinctly ſaw two of theſe filaments (*fig.* 2.) were joined together, and had a vibration, nearly like that of two extended ſtrings, which were tied at the two extremities, and pulled aſunder in the middle. Theſe filaments were compoſed of globules which touched each other, and reſembled beads. I afterwards ſaw filaments which ſwelled in certain

PLATE. I.

FIG. 1

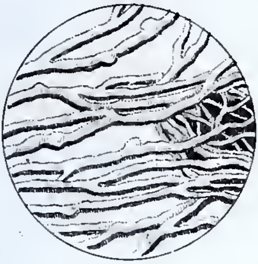


FIG. 2

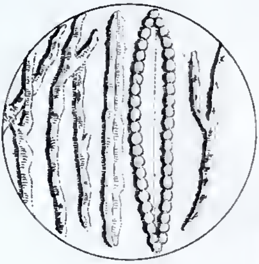


FIG. 3

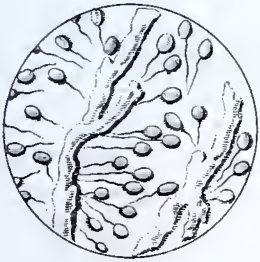


FIG. 4

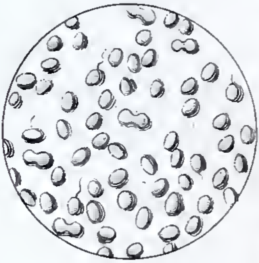


FIG. 5

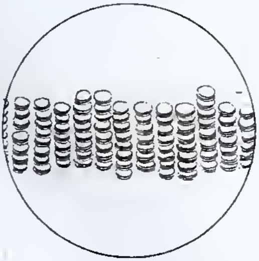
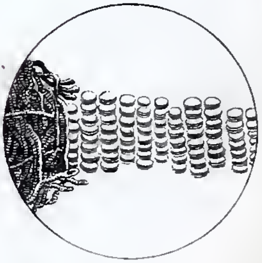


FIG. 6



tain parts, and I obſerved, that on the ſide ſo ſwelled ſmall globules came out, which had a diſtinct motion like that of a pendulum; theſe ſmall bodies were faſtened to the filaments by a ſmall thread, (*fig.* 3.) which lengthened gradually as the little body moved; and at laſt I ſaw theſe little bodies entirely ſeparated from the large filament, carrying after them the ſmall thread which connected them. As this liquor was very thick, and the filaments too near each other, I dilated another drop with rain water, in which I was aſſured there were no animals. I then ſaw the filaments much ſeparated, and very diſtinctly perceived the motion of theſe little bodies, which was now more free, and they ſwam much quicker; and if I had not ſeen them ſeparate from the filaments, and carry along with them their thread, I ſhould have taken the moving body in this ſecond obſervation for an animal, and the thread for its tail. I then attentively obſerved one of theſe filaments, that was much thicker than theſe ſmall bodies, and I had the ſatisfaction of ſeeing two of thoſe bodies which ſeparated with difficulty, drag along with them a long and ſmall thread, which obſtructed their motion.

This

This ſeminal liquor was at firſt very thick, but by degrees it became more fluid; in leſs than an hour it was almoſt tranſparent; and in proportion as this fluidity increaſed the phenomena changed, as I ſhall relate.

II. When the ſeminal liquor attained more fluidity, the filaments were no longer to be ſeen, but the little bodies appeared in great numbers; they have for the moſt part a motion like that of a pendulum, and they draw after them a long thread, which it may clearly be perceived they want to get rid of; their motion forwards is very ſlow, vibrating to the right and left. The motion of a boat faſtened in the midſt of a rapid ſtream to one fixed point, pretty well repreſents the motion of theſe bodies, excepting that the boat remains in the ſame place, whereas they advance by degrees; but they do not always keep the ſame parts in the ſame direction; but at each vibration they take a conſiderable rolling motion; ſo that, beſides their horizontal motion, they have one of a vertical balance, which proves that theſe bodies are of a globular figure, or, at leaſt, that their loweſt part is not ſufficiently extended to maintain them in the ſame poſition.

III. At the end of two or three hours, when the liquor was more fluid, we ſaw a greater quantity of theſe moving bodies. They ſeemed to be more free; the threads were ſhorter; their progreſſive motion was more direct, and their horizontal motion was greatly diminiſhed; for the longer the threads are the greater is the angle of their vibration; and in proportion as theſe threads diminiſh in length, the vibratory motion leſſens, and the progreſſive motion increaſes. The vertical balance ſtill ſubſiſted, and was always plainly perceptible.

IV. In five or ſix hours the liquor attained its utmoſt fluidity. Moſt of theſe moving ſubſtances were entirely diſengaged from their threads; they were of an oval figure, (*fig.* 4.) and moved progreſſively with great ſwiftneſs, and by their various motions had a ſtronger reſemblance than ever to real animals. Thoſe who had their threads ſtill adhering, were not ſo briſk as the others; and among thoſe that had not threads, ſome ſeemed to change their ſhape and ſize, ſome were round, ſome oval, and others thicker at their extremities than in the middle; the balancing and rolling motion was ſtill obſervable.

V. At the end of twelve hours a kind of gelatinous matter was ſettled to the bottom of the bottle: it was of an aſh-colour, and of a tolerable conſiſtency; the liquor that ſwam above was almoſt as clear as water, with a kind of bluiſh tint, reſembling water in which a little ſoap had been diſſolved; nevertheleſs it ſtill preſerved its viſcidity. The moving bodies had then a great activity, were looſened from their threads, and moved in all directions. I ſaw ſome of them change their form, and from oval become round; and others ſeparate and from one oval form two. As they became ſmaller, their activity encreaſed.

VI. In twenty-four hours the liquor had depoſited a greater quantity of gelatinous matter. I diluted it with water, but it did not readily mix, and required a conſiderable time to diſſolve. It then appeared compoſed of an infinite number of opaque tubes that formed a kind of net-work, in which no regular diſpoſition nor the leaſt motion could be ſeen: in the clear liquor ſome few ſmall bodies were ſtill moving. The next morning there were alſo a very few; but after that time I ſaw no more in this liquor than the globules, without any appearance of motion.

Theſe experiments were repeated ſeveral times with the moſt poſſible exactneſs; and I am perſuaded that thoſe threads above mentioned are not tails, nor do they make any part of the individual body; for theſe threads have no proportion with the reſt of the body; they are of different ſizes, although the moving bodies are always nearly of the ſame, at the ſame time. The globule appears embarraſſed in its motion, as its tail is longer or ſhorter; ſometimes it cannot advance, but move only from right to left, or from left to right, when the tail is very long; and it is clearly ſeen that they uſe great efforts to get rid of them.

VII. Having taken the ſeminal liquor from another man but juſt dead, and ſtill warm, I put a drop of it on the table of the microſcope, and it immediately liquified; it had at firſt a condenſed appearance, and ſeemed to form a compact web, compoſed of long and thick filaments, which grew from the thickeſt part of the liquor. Theſe filaments ſeparated in proportion as the liquor became more fluid, and at length they divided into globules, which at firſt ſeemed not to have ſufficient power to ſet themſelves in motion, but this power increaſed as they ſeparated from the filament, from which they made many efforts to diſengage themſelves. Each of them in this ſtruggle drew out tails from the filaments of different ſizes, ſome of which were ſo thin and ſo long as to have no proportion with the bodies, which were all ſo much the more embarraſſed as theſe threads or tails increaſed in length. The angle of their vibratory motion was alſo much greater as thoſe filaments were longer: and their progreſſive motion ſo much the more remarkable as theſe tails were ſhorter.

VIII. Having continued theſe obſervations for fourteen hours, I perceived that theſe threads, or tails, were continually leſſening, and became ſo fine, that at laſt their extremities were no longer viſible, and at length the whole entirely diſappeared. At this time the globules abſolutely ceaſed their horizontal vibrations; their progreſſive motion was direct, although they had always the vertical balancing motion, like the rolling of a ſhip. When diſencumbered of theſe threads, the bodies were oval, tranſparent, and perfectly like thoſe pretended animals ſeen in the liquor of an oyſter on the ſeventh day; and ſtill more to thoſe found in the jelly of roaſt veal at the end of the fourth day.

IX. Between the tenth and eleventh hour the liquor became extremely fluid, and all the globules appeared to proceed in ranks from one and the ſame ſide; (*fig.* 5.) they paſſed over the table of the microſcope in leſs than four ſeconds; they were ranged ſeven or eight in front, and moved on ſucceſſively, as troops march in files. I obſerved this ſingular inſtance for more than five minutes; and as their courſe did not finiſh, I was deſirous of finding the ſource: and, having gently moved my glaſs, I perceived that all theſe moving globules came from a kind of mucilage, (*fig.* 6.) where the filamentary net-work continually produced them more abundant and much quicker than the filaments had ten hours before. There was ſtill a remarkable difference between theſe moving bodies produced in the thick liquor, and thoſe produced when the liquor became more fluid; theſe laſt had no thread behind them, their motion was quicker, and they went in flocks like ſheep. I obſerved the mucilage from whence they iſſued for ſome time, and perceived it diminiſhed, and was ſucceſſively converted into moving globules, till the diminution of more than half the bulk; after which, the liquor being too dry, this mucilage became obſcure in its middle, and all the environs were divided by the ſmall threads which appeared to be formed from the bodies of theſe moving globules which were deſtroyed as it dried up, not in one ſingle maſs, but in long threads, regularly diſpoſed, with quadrangular intervals, forming a net-work, very like to a cobweb, on which the moiſture hung in an infinite number of globules.

X. I perceived by the firſt experiment, that theſe little moving bodies change their form, and I thought they in general diminiſhed, but of that I was not certain. In this laſt obſervation, at the twelfth and thirteenth hour I obſerved it more diſtinctly; at the ſame time remarking that though diminiſhed conſiderably in ſize, yet they increaſed in ſpecific gravity; eſpecially when their motion was nearly finiſhed, which generally happened all at once, and they ſunk to the bottom, forming a ſediment of an aſh-colour, plainly perceptible to the naked eye, and which appeared through the microſcope to be compoſed of globules adherent to one another, ſometimes by threads, and at others in knots, but always in a regular manner.

XI. Having procured the ſeed of a dog, emitted naturally, I obſerved that this liquor was clear, and had but little tenacity. I put it in a phial, and having examined it with a microſcope, without diluting it with water, I perceived moving bodies, entirely like thoſe I had obſerved in the human ſemen; they had threads, or tails, perfectly the ſame; they were alſo nearly of the ſame ſize; in a word, they reſembled, as perfectly as poſſible, thoſe I ſaw in the human liquor, liquified during two or three hours. I then ſought for the filaments which I had ſeen in the human liquor, but it was uſeleſs; I perceived only ſome long threads entirely like thoſe which ſerved as tails to the globules. Theſe threads were not attached to any globules, nor had they any motion. Thoſe globules which were in motion, and had tails, appeared to me to move quicker than thoſe in the human ſemen: they had ſcarcely any horizontal vibrations, but a rolling motion. They were not in a great number; and although their progreſſive motion was ſtronger, they took more time to croſs the microſcope than thoſe I had before remarked. I obſerved this liquor for three hours, but perceived no change: after which I examined it at another time for four hours, and remarked, that the number of moving bodies diminiſhed by degrees; the fourth day there was ſtill ſome, though they were very few, and often I only found one or two in a drop of liquor. The ſecond day moſt of them were deprived of their tails; third day very few retained them; yet, at the laſt day, there ſtill remained ſome which had them; the liquor had then depoſited a whitiſh ſediment, which appeared to be compoſed of immovable globules, and many threads, that ſeemed to be tails ſeparated from the globules. There were alſo ſome attached to the globules, which appeared to be the dead bodies of theſe little animals, but whoſe forms were different from thoſe that moved, for they appeared larger than the moving globules, or the reſt which remained without motion at the bottom of the liquor, and appeared to have a fiſſure or opening.

XII. Another time, having taken the ſeminal liquor of the ſame dog, I again perceived the fore-mentioned phenomena; and I ſaw beſides in one of the drops of this liquor, a mucilaginous part, which produced moving globules, as in the ninth experiment, (*fig.* 6.) and theſe globules formed a current, and went in ranks like troops. This mucilage appeared to me animated with an internal inflated motion, which produced ſmall bloated appearances in different parts, and from which iſſued theſe bloated forms, or moving globules, with a nearly equal ſwiftneſs, and in the ſame direction. The bodies of theſe globules were not different from the reſt, excepting they had no tails. I obſerved that many of them changed their ſhape, and lengthened conſiderably, till they became little cylinders, after which the two extremities of the cylinders were bloated, and divided into two globules, both moving and following the ſame direction as that before they were united.

XIII. The phial which contained this liquor having been broke by accident, I a third time took the liquor of the ſame dog, but whether the animal was wearied by too reiterated emiſſions, or by other cauſes, the ſeminal liquor contained none of the above bodies, but was tranſparent and viſcous, like the ſerum of blood; I examined it then, and at one, two, three, and even twenty-four hours afterwards, but it preſented nothing new: there was not a ſingle moving body to be ſeen, nor any mucilage; in a word, nothing that I had ſeen before.

XIV. I then opened a dog, and ſeparated the teſticles and the adherent veſſels, but I perceived no ſeminal veſicles, and apparently the ſeed in thoſe animals paſſes directly from the teſticles into the urethra. I found but a ſmall quantity of liquor in the teſticles, although the dog was adult and vigorous. In the ſmall quantity I could collect I could not diſcover any bodies that were in motion, I only perceived a great quantity of very ſmall globules, moſt of which were motionleſs, and ſome of the ſmalleſt had ſome trifling approximating motion, which I could not follow, becauſe the drops I gathered were ſo exceedingly minute that they dried in two or three minutes after they were placed in the microſcope.

XV. Having cut the teſticles of this dog into two points, I infuſed it in water, and cloſely ſealed up the veſſel. Three days after I examined this infuſion, which I made with the deſign of diſcovering whether the fleſh did not contain moving bodies, and I ſaw a great quantity of moving bodies of a globular and oval form, like thoſe I had ſeen in the ſeminal liquor of the dog, excepting they had not any threads. They moved in all manner of directions with great ſwiftneſs. I obſerved theſe bodies, which appeared animated for ſome time, and ſaw many change their form; I perceived ſome to lengthen, and others to contract, while ſome ſwelled at both extremities: there were numbers that were ſmaller and thicker than the reſt; but they were all in motion, and were about the ſize and figure of thoſe I have deſcribed in the fourth experiment.

XVI. The next morning the number of theſe globules were increaſed, but they appeared ſmaller; their motion was more rapid and irregular; they had alſo another appearance with reſpect to their form and manner of moving, which ſeemed confuſed; the next and ſeveral days after, till the fifteenth day, there were moving bodies in the water, whoſe ſize gradually diminiſhed till they were no longer viſible. The laſt, which I perceived with great difficulty, was on the nineteenth and twentieth days, and they moved with greater rapidity than ever. Upon the water a kind of pellicle was formed, which appeared to be compoſed of the coverings of thoſe moving bodies, ſmall threads, ſcales, &c. but entirely motionleſs; this pellicle, and the moving bodies could not come into the liquor by means of external air, ſince the bottle had been kept carefully ſealed.

XVII. I then ſucceſſively opened ten rabbits, on different days, to examine their ſeminal liquors; the firſt had not a drop, either in the teſticles or ſeminal veſſels. In the ſecond I was no more ſuccefsful, although I was aſſured he was the father of a very numerous progeny. I ſucceeded no better in the third. I then imagined that the preſence of the female might be requiſite; I therefore put males and females into cages ſo contrived that it was impoſſible for them to copulate. At firſt theſe endeavours did not ſucceed; for, on opening two, not a drop of ſeminal liquor was to be found; however, in the ſixth that I opened, a large white rabbit, I found, in the ſeminal veſicles, as much liquor as could be contained in a teaſpoon; this matter reſembled calves jelly, was nearly tranſparent, and of a citron colour. Having examined it with the microſcope, I perceived it to reſolve by ſlow degrees into filaments and thick globules, many of which appeared faſtened to each other; but I did not remark any diſtinct motion in them, only as the matter liquified, it formed a kind of current, by which theſe filaments and globules ſeemed to be drawn all to one ſide. I expected to find this matter take a greater degree of fluidity, but that did not happen, for after it was a little liquified it dried, and I could perceive nothing further than what is above mentioned. When this matter was mixed with water, the latter did not appear to have power to dilute it.

XVIII. Having opened another rabbit, I only found a very ſmall quantity of ſeminal matter, which was of a colour and conſiſtency entirely different from the former; it was ſcarcely tinctured of a yellow hue, and was much more fluid. As there was but very little, I feared it would dry too haſtily, and therefore mixed it with water; from the firſt obſervation, I did not perceive the filaments I had ſeen in the other, but I diſcovered three globules, all in a trembling and reſtleſs motion: they had alſo progreſſive motion, but it was very ſlow; ſome moved round the others, and moſt appeared to turn upon their centres. I could not purſue this obſervation becauſe the liquor ſo ſoon got dry.

XIX. I opened another of theſe rabbits, but could not diſcover any of this matter; in the ſeminal veſſels of another, I found almoſt as much congealed liquor as in XVIIth Experiment: I examined it in the ſame manner as the reſt, but it afforded me no greater diſcovery. I infuſed the whole I had collected, in almoſt double the quantity of water, and after briſkly ſhaking them together, I ſuffered them to ſettle for ten minutes; after which, on inſpecting this infuſion, I ſaw the ſame large globules as before; there were but few and thoſe very diſtant from each other. They had approximating motions with reſpect to each other, but they were ſo ſlow, as to be ſcarcely diſcernible; two or three hours after, theſe globules ſeemed to be diminiſhed, their motion was become very diſtinct, and they appeared to turn on their centre. Although this trembling motion was more than their progreſſive, nevertheleſs they were clearly ſeen to change their ſituation irregularly with reſpect to each other. Six or ſeven hours after the globules were become ſtill leſs, and their action was increaſed: they appeared to me to be in much greater numbers, and all their motions diſtinct. The next morning there was a prodigious multitude of globules in motion, which were at leaſt three times ſmaller than thoſe that at firſt appeared. I obſerved theſe globules for eight days, and obſerved that many of them ſeemed to join together, after which their motion ceaſed; this union, however, appeared to me only ſuperficial and accidental. Some were larger than others; moſt were round and ſpherical, and ſome of them were oval. The largeſt were moſt tranſparent, and the ſmalleſt were almoſt black. This difference did not proceed from the light, for in whatever ſituation theſe ſmall globules were in, they were always of the ſame appearance; the motions of the ſmall were much more rapid than the large ones, and what I remarked moſt clearly and moſt generally in all, was their diminution of ſize, ſo that at the eighth day they were ſo exceedingly ſmall as to be hardly perceptible, and at laſt abſolutely diſappeared.

XX. At length having obtained, with no ſmall difficulty, the ſeminal liquor of another rabbit, as it would have been conveyed to the female, I remarked it to be more fluid than that which had been taken from the ſeminal veſicles, and the phenomena which it offered were alſo very different; for in this liquor there were moving globules and filaments without motion; and alſo a kind of globules with threads or tails, reſembling thoſe of a dog or a man, but only appearing ſmaller and briſker (*fig.* 7.).

(*fig.* 7.) They paſſed over the microſcope in an inſtant, their tails appeared ſhorter than thoſe of other ſpermatic animals, and I own I am not certain whether ſome of thoſe tails were not falſe appearances, produced by the furrows which theſe moving globules formed in the liquor, as they moved with too great a rapidity to admit of my clearly obſerving them; beſides, the liquor, though ſufficiently fluid at firſt, very ſpeedily dried away.

XXI. After this I reſolved to examine the ſeminal liquor of a ram; I applied to a butcher, who ſupplied me with the neceſſary parts of at leaſt twelve or thirteen, directly after they were killed, but I could not find liquor ſufficient for any experiment, either in the epididymis or ſeminal veſicles. In the little drops I was able to collect, I only perceived globules which had no motion. As I made theſe experiments in March, I ſuppoſed by repeating them in October, the ſeaſon of female attachments, I ſhould diſcover more ſeminal liquor in theſe veſſels. I cut many of theſe teſticles in two longitudinally, and collected a ſmall quantity of liquor, but found nothing more in them.

XXII. I took three of theſe teſticles, of three different rams, cut each of them into four parts,

PLATE. II

FIG.7

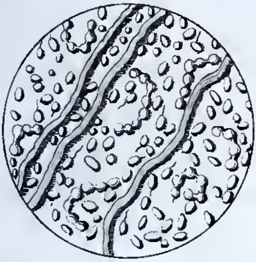


FIG.8

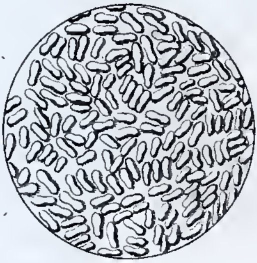


FIG.9

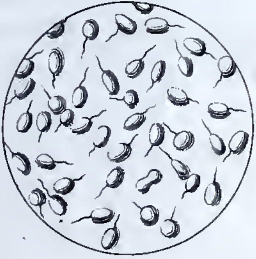


FIG.10

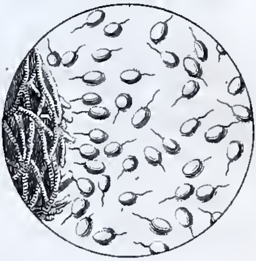


FIG.11

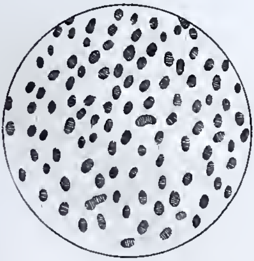
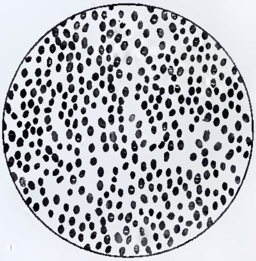


FIG.12



parts, and put them into ſeparate bottles, with as much water as was ſufficient for them. Securing theſe bottles from the admiſſion of air, I ſuffered the infuſion to remain for four days, after which I examined the liquor of each by the microſcope, and found them all replete with an infinity of moving bodies, moſt part of which were oval, and the reſt globular; they were pretty thick, and reſembled thoſe deſcribed in the VIIIth experiment; their motion was neither briſk, uncertain, nor very rapid, but equal, uniform, and in all directions. Theſe moving bodies were nearly of the ſame ſize in each liquor, but differed one bottle with the other. They had no tails, nor were there any filaments or threads in this liquor; during the fifteen or ſixteen days they were retained, they often changed their form, and ſeemed ſucceſſively to throw off their external coverings; they alſo became every day ſmaller, and on the ſixteenth day they were no longer perceptible.

XXIII. In the month of October I opened a ram, and found a great quantity of ſeminal liquor in the epididymis; having examined it with the microſcope, I perceived an innumerable multitude of moving bodies, ſo numerous, that all the liquor ſeemed to be entirely compoſed of them; as it was too thick, I diluted it with water, but I was ſurpriſed to ſee the motion of theſe bodies ſuddenly ſtop, though I perceived them very diſtinctly; having many times repeated the ſame obſervation; I perceived that the water which diluted the ſeminal liquors of a man, dog, &c. ſeemed to coagulate that of a ram.

XXIV. I then opened another ram, and in order to prevent the ſeminal liquor from coagulating, I permitted the parts of generation to remain in the body of the animal, and covered it over with warm cloths. By theſe precautions I obſerved the ſeminal liquor in its fluid ſtate; it was replete with an infinity of oblong moving bodies, (*fig.* 8.) tranſverſing in various directions; but as ſoon as the liquor grew cold, the motion of all theſe bodies immediately ceaſed. I diluted the liquor with warm water, when the motion of the ſmall bodies remained for three or four minutes. The quantity of theſe moving bodies was ſo great in this liquor, that although diluted, they nearly touched each other. They were all of the ſame ſize and form, but none of them had tails. Their motion was not very quick, and when it ſtopped by the coagulation of the liquor, and they did not change their form.

XXV. As I was perſuaded, not only by my own theory, but alſo by the obſervations of all thoſe who had made experiments before me, that the female, as well as the male, has a ſeminal and prolific liquor; and as I had no doubt but the reſervoir of this liquor was the glandular body of the teſticle, where prejudiced anatomiſts attempted to find the egg, I purchaſed ſeveral dogs and bitches, and ſome male and female rabbits, which I kept ſeparate from each other; and in order to have a comparative object with the liquor of the female, I again obſerved the ſeminal liquor of a dog, and diſcovered there the ſame moving bodies as deſcribed in the XIth experiment.

XXVI. While I was thus occupied, a bitch was diſſected which had been four or five days in heat, and had not received the dog. The teſticles were readily found, and on one of them I diſcovered a red, glandular, prominent body, about the ſize of a pea, which perfectly reſembled a little nipple; on the outſide was a viſible orifice formed by two lips, one of which jutted out more than the other.

Having introduced a ſmall inſtrument into this orifice, a liquor dropped from it, which we carefully caught to examine with the microſcope. The ſurgeon replaced the teſticles in the body of the animal, which was yet alive, in order to keep them warm. I then examined this liquor with a microſcope, and at the firſt glance had the ſatisfaction to ſee moving bodies with tails, exactly like thoſe I juſt before ſaw in the ſeminal liquor of the dog (*fig.* 9.) Meſſrs. Needham and Daubenton, who obſerved them with me, were ſo ſurprized at this reſemblance, that they could ſcarcely believe but that theſe ſpermatic animals were the ſame, and thought I had forgotten to change the table of the microſcope, or that the inſtrument with which we had gathered the liquor of the female, might before have been uſed for the dog. Mr. Needham then took different inſtruments, and having obtained ſome freſh liquor, he examined it firſt, and ſaw there the ſame kind of animals, and was convinced, not only of the exiſtence of ſpermatic animals in the ſeminal liquor of the female, but likewiſe of their reſemblance to thoſe of the ſemen of the male. We repeated it ten times at leaſt in different drops of the ſame liquor, without perceiving the ſmalleſt variation in the phenomena.

XXVII. Having afterwards examined the other teſticle, I found a glandular body in its growing ſtate; it had not any external orifice, was much ſmaller, and not ſo red as the firſt. Having opened it, I found no liquor but only a ſmall fold in the internal part, which I judged to be the origin of the cavity that was to contain the liquor. This ſecond veſicle had ſome very lymphatic veſicles externally. I pierced one of them with a lance, and a clear and limpid liquor flowed out, which I examined with the microſcope; it contained nothing ſimilar to that of the glandular body; it was a clear matter, compoſed of ſmall globules, which were motionleſs. Having often repeated this obſervation, I was aſſured, that this liquor in the veſicles was only a kind of lymph, which contains nothing animated, or ſimilar to that ſeen in the female ſeed, which is formed and perfected in the glandular bodies.

XXVIII. Fifteen days after I opened another bitch that had been in heat ſeven or eight days, but had not received the dog. I found the teſticles contiguous to the extremities of the horns of the matrix; theſe horns were very long, their external tunic ſurrounded the teſticles, and they appeared covered with that membrane like a cowl. In each teſticle I found a glandular body in its full maturity. The firſt was half open, and there was a paſſage which penetrated into the teſticle, and which was replete with ſeminal liquor; the ſecond was ſomewhat more large and prominent, and the orifice, or canal, which contained the liquor was below the nipple. I took theſe two liquors, and having compared them, found them perfectly alike.. The ſeminal liquor of the female is at leaſt as liquid as that of the male. Having afterwards examined the two liquors with the microſcope, I perceived the like moving bodies, (*fig.* 10.) and the ſame phenomena, as in the ſeminal liquor of the other. I ſaw beſides many globules which moved very briſkly, and endeavoured to diſengage themſelves from the mucilage that ſurrounded them: there was as great a quantity of them as in the ſeed of the male.

XXIX. From theſe glandular bodies I preſſed out all the liquor, and having collected it, I found enough to laſt for four or five hours obſervations. I remarked that it depoſited ſomewhat to the bottom, or at leaſt began to thicken. I took one drop of this, which was thicker than the reſt, and having put it on the microſcope, perceived that the mucilaginous part of the ſeed was condenſed, and formed a continued net-work. On the external border of this net-work there was a torrent or current, compoſed of globules, which moved with rapidity. Theſe globules were lively, active, and appeared to be diſengaged from their mucilaginous covering, and their tails. This ſtream perfectly reſembled the courſe of the blood in ſmall tranſparent veins; for they appeared not only to be animated by their own powers, but alſo to be impelled by a common force, and conſtrained to follow in an herd. From this experiment, and the XIth and XIIth, I concluded, that when the fluid begins to coagulate and thicken, theſe active globules break and tear their mucilaginous coverings, and eſcape by that ſide where the liquor remains moſt fluid. Theſe moving bodies had then neither thread nor tails: they were for the moſt part oval, and appeared to be flat at the bottom, for they had no rolling motion.

XXX. The horns of the matrix were externally ſoft; I opened them longitudinally, and only found a very ſmall quantity of liquor, which upon examination appeared to contain the ſame as that preſſed from the glandular ſubſtance of the teſticle. Theſe glandular bodies are placed ſo as eaſily to ſprinkle this liquor on the horns of the matrix; and I am perſuaded that, as long as the amorous ſeaſon remains, there is a continual dropping of this liquor from the glandular ſubſtance into the horns of the matrix; that this dropping remains till the glandular ſubſtance has emptied the veſicles; it then becomes fluid by degrees, is effaced, and only leaves a little reddiſh cicatrice on the external part of the teſticle.

XXXI. I took this ſeminal liquor of the female, with the ſame quantity of that juſt emitted from the male, and mixed them together, and having examined this mixture with the microſcope, I perceived nothing new, the liquor remaining the ſame, and the moving bodies were ſo ſimilar, that it was impoſſible to diſtinguiſh thoſe of the male from thoſe of the female; I only thought their motion appeared a little ſlackened.

XXXII. Having diſſected a young bitch that had never been in heat, I only diſcovered a ſmall protuberance on one of the teſticles, which I ſuppoſed to be the origin of a glandular body. The ſurface of the teſticles was ſmooth and even, and the lymphatic veſſels could ſcarcely be ſeen externally, until the tunic, which covered the teſticles, was ſeparated; but theſe veſicles were not conſiderable, and contained but a ſmall quantity of liquor, in which I could only perceive ſome little globules without any motion.

XXXIII. In another bitch, which was younger, and only three or four months old, there was no appearance of glandular bodies on the teſticles; they were white, ſmooth, and covered with a cowl like the reſt. There were ſome little veſicles which contained little or no liquor; and it was with great difficulty we could perceive any veſicles externally. I compared one of theſe teſticles with that of a young dog of nearly the ſame age, and they appeared internally of a fleſhy nature, and perfectly ſimilar. I do not mean to contradict what ſome anatomiſts have ſaid concerning the teſticles of dogs, but only that the appearance of the internal ſubſtance of the female teſticles is like that of the males, when the glandular ſubſtances are not yet grown.

XXXIV. The

XXXIV. The genital parts of a cow, which had been juſt killed, was ſent to me, covered over with hot cloths, and put into a baſket with a live rabbit, which likewiſe ſquatted on a cloth at the bottom, ſo that I received them almoſt as warm as when taken out of the body. I immediately inſpected the teſticles, and found them of the ſize of a hen's, or at leaſt a pigeon's egg. One of theſe teſticles had a glandular body, about the ſize of a pea, protuberating outwardly like a ſmall nipple, but it was not pierced, nor had any external orifice: it was cloſe and hard. I preſſed it with my fingers, but no liquor iſſued from it. I obſerved, before this teſticle was diſſected, there were two other glandular ſubſtances at a diſtance from the other, but theſe were juſt began to grow; their colour was a whitiſh yellow, whereas that which ſeemed to have pierced the membrane of the teſticle was of a roſe colour. I opened this laſt, and examined it with the greateſt attention, but could not diſcover that it contained any liquor, I therefore judged that it was far diſtant from its maturity.

XXXV. The other teſticle had no glandular body which had pierced the common membrane that covered the teſticle, there were only two ſmall ones, which began to form a little protuberance below this membrane. I opened both of them but no liquor iſſued therefrom: they were hard, whitiſh, and with a yellow tint; each of them had four or five lymphatic veſicles, very eaſily diſtinguiſhable on their ſurface, and appearing tranſparent I judged they contained a quantity of liquor, and having pierced them with a lancet the liquor iſſued out to ſome inches diſtance. I collected a ſufficient quantity of this liquor to obſerve it eaſily; I only ſaw ſome very minute immoveable globules; and although I continued my examination for two days, I neither diſcovered alteration, change, nor motion therein.

XXXVI. Eight days after, two more genital parts were brought to me in the ſame mode as the laſt. I was aſſured that one was taken from a young cow that had never calved, and the other from one that had had ſeveral, but was not old. I firſt examined the teſticles of the latter, and on one of them I found a glandular ſubſtance, as large and as red as a cherry, which appeared a little ſoft towards the nipple. I diſtinguiſhed three ſmall holes, in which a hair might be introduced. Having preſſed this ſubſtance with my fingers a ſmall quantity of liquor iſſued, which I placed on the table of a microſcope, and had the ſatisfaction to ſee ſome moving globules there, but quite different from thoſe which I had ſeen in other ſeminal liquors (*fig.* 11.) Theſe globules were obſcure and little; their progreſſive motion, although diſtinct, was nevertheleſs very ſlow. The liquor was not thick; the little globules had no appearance of threads, or tails, and they were not in motion. This is all I was able to perceive in the liquor this glandular ſubſtance afforded me, for although I preſſed it again it only afforded a leſs quantity, mixed with blood. I again diſcovered in it the ſmall moving globules, but they ſeemed to be at leaſt four times ſmaller than the ſanguinary globules.

XXXVII. This glandular body was ſituate at one of the extremities by the ſide of the horn of the matrix, and the liquor, which it prepares, muſt fall upon this horn; nevertheleſs, on opening this horn I found no material quantity of liquor. This glandular body penetrated very forward in the teſticle, and occupied more than a third of its internal ſubſtance.

I opened them longitudinally, and found a pretty large cavity, but entirely void of any liquor. At ſome diſtance from this glandular body there was a ſmall one of the ſame kind, about the ſize of a lentil. There were alſo two ſmall cicatrices, about the ſame ſize, which formed two ſmall indentions, of a deep red colour: they were the remains of obliterated glandular bodies. Having afterwards examined the other teſticle I counted four cicatrices and three glandular bodies, the foremoſt of which had pierced the membrane, was of a fleſh colour, and the ſize of a pea: it was ſolid, and without any orifice or liquor: the two others were ſmaller, harder, and of a deep orange colour. On the firſt teſticle only two or three apparent lymphatic veſicles remained. I counted eight on the external part, and having examined the liquor of theſe veſicles I perceived only a tranſparent matter, without any moving bodies.

XXXVIII. I then examined the teſticles of the young cow which had not calved; which, notwithſtanding, were ſomething larger than the other, but it is true there were no cicatrices on either of them; the one was ſmooth and very white, and a number of lymphatic veſicles were ſprinkled about it, but there was not the leaſt mark of a glandular body. On the other teſticle I perceived the marks of two glandular ſubſtances, the one had juſt began to grow, and the other was the ſize of a pea; there were alſo a great number of lymphatic veſicles, which I pierced with a lancet, but the liquor did not contain any thing; having pierced the two ſmall glandular bodies ſome blood alone iſſued thereout.

XXXIX. I divided each teſticle of both cows into four parts, and having put them into ſeparate phials, I poured as much water on as would cover them, and after having cloſely corked them up I ſuffered to infuſe for ſix days; I then examined theſe infuſions, and diſcovered an innumerable quantity of living moving bodies (*fig.* 12.); they were all, in theſe infuſions, extremely ſmall, moved with a ſurpriſing rapidity in all directions. I obſerved them for three days, and they always appeared to diminiſh, till at laſt, on the third day, they entirely diſappeared.

XL. The following day they brought to me the genital parts of three more cows, I immediately ſearched the teſticles to find one where the glandular ſubſtance was in perfect maturity; but in two of them I only diſcovered ſome growing glandular ſubſtances on the teſticles. I could not learn whether theſe cows had calved or not, but there was a great appearance they had all been in ſeaſon, for there were a great number of cicatrices on all theſe teſticles. In the third I found a teſticle, on which was a glandular ſubſtance, as thick and as red as a cherry; it was inflamed, and ſeemed to be in full maturity. Its extremity was a nipple, with a ſmall hole; I preſſed it a little between my fingers, and a quantity of liquor iſſued out. I found in this liquor moving globules, exactly like thoſe in the liquor preſſed from the glandular body of the other cow, I have before ſpoken of in experiment XXXVI. They appeared to be more numerous, their progreſſive motions were not ſo ſlow, and their ſize larger. Having obſerved them for ſome time I perceived ſome to lengthen and change their form. I then introduced a very fine inſtrument into the little hole of the glandular ſubſtance, and having opened it I found the internal cavity replete with liquor; this liquor offered me the ſame phenomena, and the ſame moving globules, as I before obſerved in experiment

ment XXXVI. with either filaments, threads, or tails attached to them. The liquor of the veſicle preſented me with nothing more than nearly a tranſparent matter, which did not contain one moving thing.

XLI. At different times they brought me the genitals of ſeveral other cows. In ſome I found the teſticles loaded with an almoſt mature glandular ſubſtance; in others they were of different growths, and I remarked nothing new, excepting that in the two teſticles of two different cows I perceived the glandular ſubſtance in a decayed ſtate; the baſe of one was as broad as the circumference of a cherry; the extremity of the nipple was ſoft, wrinkled, and ſhrivelled; the two ſmall holes were very perceptible, from whence the liquor had flowed. With ſome difficulty I introduced a ſmall hair, but there was no liquor in the canal, nor in the internal cavity, which was ſtill to be ſeen. The flaccidity of theſe glandular ſubſtances begins, therefore, at the moſt external part, or extremity of the nipple. They diminiſh at firſt in height, and afterwards in breadth, as I obſerved in another teſticle, where this glandular ſubſtance had diminiſhed more than three fourths.

XLII. As the teſticles of doe rabbits, as well as the glandular bodies formed there, are very ſmall, I could obſerve nothing very exactly with reſpect to their ſeminal liquor. I only diſcovered, that the teſticles of doe rabbits are different, and that none of thoſe I ſaw reſembled what De Graaf repreſents in his engravings; for the glandular ſubſtances did not encloſe the lymphatic veſſels; and I never ſaw a pointed end, as he has depicted them.

XLIII. I found on the teſticles of ſome cows a kind of bladders, replete with tranſparent liquor. I remarked they were of different ſizes, the largeſt about that of a pea; they were faſtened to the external membrane of the teſticle by a ſtrong membraneous pedicle, as was alſo another, ſtill ſmaller; and a third, nearly of the ſame ſize as the ſecond, appeared to be only a lymphatic veſicle, much more apparent than the reſt. I imagined theſe bladders, which the anatomiſts have called *hydatides*, might poſſibly be of the ſame nature as the lymphatic veſicles of the teſticles, for having examined the liquor they contained I found it to be perfectly ſimilar; it was a tranſparent and homogeneous liquor, which did not contain one moving ſubſtance.

XLIV. At the ſame time I made obſervations on the liquor in an oyſter; on the water in which pepper had been boiled; on the water wherein pepper had been only infuſed; and on the water wherein I had put ſome vegetable ſeed; the bottles which contained theſe waters were firmly cloſed, and in two days I perceived in the oyſter liquor a greater quantity of oval and globular ſubſtances, which ſeemed to ſwim like fiſh in a pond, and had all the appearance of being animals; however they had no limbs nor tails, but were very large, tranſparent, and viſible. I perceived them change their forms, and become ſmaller for ſeven or eight days ſucceſſively; and at length I and Mr. Needham obſerved animals ſimilar to thoſe in an infuſion of jelly of roaſt veal, which had been alſo very exactly corked; ſo that I am perſuaded they are not real animals, at leaſt according to the received acceptation of the words, as we ſhall hereafter explain.

The infuſion of the ſeed preſented an innumerable multitude of moving globules which appeared animated like thoſe of the ſeminal liquors, and in the infuſions of the fleſh of animals: theſe were alſo large, and in violent motion during the firſt days, but they diminiſhed by degrees, and diſappeared only from their minuteneſs.

I perceived the ſame thing, but later, in the liquor wherein pepper had been boiled, and the like, though ſtill later, in that which had not boiled; from hence I ſuppoſed that what is called fermentation may poſſibly be only the effect of the motion of theſe organical parts of animals and vegetables; and in order to ſee what difference there was between this kind of fermentation and that of minerals, I placed a little powdered ſtone on the microſcope, and ſprinkled thereon a drop of aqua-fortis, which however produced a different phenomena, conſiſting of great balls, which aſcended to the ſurface, and almoſt inſtantaneouſly obſcured the focus of the microſcope; this was a diſſolution of the groſſer parts, which being completed it became motionleſs, and had not the ſmalleſt reſemblance to the other infuſions I had obſerved.

XLV. I examined the ſeminal liquor in the roes of different fiſh; ſuch as carp, tench, barbel, &c. which I took out while they were living,

ving, and having obſerved three different liquors with great attention, I perceived a great quantity of obſcure globules, all in motion. I took ſeveral more of theſe fiſh alive, and with my fingers gently compreſſed that part of the belly where this liquor is emitted; and in that which I obtained, I perceived an infinity of moving globules therein, very black and very ſmall.

XLVI. Before I finiſh this chapter I ſhall relate the experiments of Mr. Needham on the ſeed of a kind of cuttle fiſh, called calmar. This able naturaliſt having ſought for ſpermatic animals in the milts of many different fiſh, found them in the roe of a calmar, apparent to the naked eye. During the ſummer he diſſected calmars at Liſbon, but found no appearance of any roe, nor any reſervoir which appeared to be deſtined for the reception of the ſeminal liquor; and it was in the middle of December that he began to diſcern the firſt traces of a new veſſel replete with a milty juice. This reſervoir increaſed, and the ſeed which it contained was diffuſed very abundantly. By examining this liquor with the microſcope, he perceived only ſmall opaque globules, which floated in a kind of ſerous matter, without the leaſt appearance of life. But ſome time after, in the milt of another calmar, he found theſe organic parts completely formed; they ſeemed like ſpiral ſprings ſhut up in a kind of tranſparent caſe. They appeared as perfect at firſt as they did at laſt, excepting that by degrees they contracted and formed a kind of ſcrew. The lid of the caſe was a ſpecies of valve that opened outwardly, and by which all the contents might iſſue; it contained another valve, a barrel, and a ſpongy ſubſtance; therefore the whole machine conſiſted in an external, tranſparent, and cartilaginous caſe, whoſe upper extremity is terminated by a round head, formed by the caſe itſelf, and which performs the office of a valve. In this external caſe is contained a tranſparent tube, which encloſes the ſpring, piſton, or valve, barrel, or ſpongy ſubſtance. The ſcrew occupies the upper part of the tube and caſe, the piſton and barrel are placed in the middle, and the ſpongy ſubſtance occupies the lower part. Theſe machines pump up the lacteal liquor, of which the ſpongy ſubſtance is full; and before the animal ſpawns, the whole milt is no more than a compoſition of theſe organic parts, which have abſolutely pumped up the lacteal liquor. As ſoon as theſe little machines are taken from the body of the animal, and depoſited either in water, or held in the air, they begin to act; the ſpring aſcends, followed by the piſton, the barrel, and the ſpongy ſubſtance which contains the liquor; and as ſoon as the ſpring and the tube which contain it begins to quit the caſe, the ſpring folds up; and all that remains within begins to move, till the ſpring, the ſucker, &c. are entirely come out: as ſoon as that is done, the remainder immediately follow, and the lacteal liquor, which has been pumped out, and which was contained in the ſpongy ſubſtance flows out by the barrel.

As this obſervation is very ſingular, and inconteſtibly proves that the moving bodies found in the milt of the calmar are not animals, but ſimple machines, a kind of pumps, I have deemed it neceſſary to give Mr. Needham's own words*.

" When the ſmall machines, he ſays, are arrived to their perfect maturity, many of them act the moment they are in the open air; nevertheleſs moſt of them may be commodiouſly placed, ſo as to be ſeen with a microſcope, before their action begins; and even to make them act, the upper extremity of the external caſe muſt be moiſtened with a drop of water, which then begins to expand, while the two ſmall ligaments which iſſue from the caſe twiſt and turn in different manners: at the ſame time, the ſcrew aſcends ſlowly, the volutes, which are at its upper end, approach and act againſt the top of the caſe: thoſe at the bottom alſo advance, and ſeem to be continually followed by others which come from the piſton. I ſay, they ſeem to be followed, becauſe I do not think they are ſo effectually, but only a deception produced by the nature and motion of the ſcrew. The piſton and barrel alſo follow the ſame direction, extend lengthways, and at the ſame time move towards the top of the caſe, which is perceived by the vacuum at the bottom. As ſoon as the ſcrew, with the tube in which it is encloſed, begins to appear externally from the caſe, it folds, becauſe it is retained by its two ligaments: nevertheleſs, all the internal contents continue to move gently and gradually, until the ſcrew, piſton, and bladder are entirely come out. When that is done, the reſt follow directly after. The piſton ſeparates from the barrel, and the apparent ligament, which is below the latter, ſwells and acquires a diameter equal to that of the ſpongy ſubſtance which follows it. This, although much larger than when in the caſe, becomes ſtill five times longer than before. The tube which incloſes it all is ſtraitened in its middle, and forms two kinds of knots, about a third of its length diſtant from each extremity: the ſemen then flows through, and is compoſed of ſmall opaque globules, which float in a ſerous matter, without ſhewing any ſigns of life, and which are preciſely ſuch as I have ſaid to have ſeen them when they were diffuſed in the reſervoir of the milt. In the figure, the part between the two knots ſeems to be broken: when it is examined attentively, we find that what cauſes it to appear as ſuch is, that the ſpongy ſubſtance within the tube is broken in nearly equal pieces, which the following phenomena will clearly prove. Sometimes it happens, that the ſcrew and the tube break by the piſton, which remains in the barrel; then the tube cloſes in a moment, and takes a conical figure, by contracting as much as it is poſſible above the end of the ſcrew, which demonſtrates its great elaſticity in that part: and the manner which it accommodates itſelf with the figure of the ſubſtance it incloſes, when it receives the leaſt change, proves that it is equal in every other reſpect."

---

* See New Diſcoveries made with the microſcope by Mr. Needham, chap. vi. Leyden, 1747.

Mr. Needham from this conceives that we might imagine the actions of all this machine were owing to the ſpring of the ſcrew, but he proves by many experiments that the ſcrew, on the contrary, only obeys a power which reſides in the ſpongy part. As ſoon as the ſcrew is ſeparated from the reſt, it ceaſes its action, and loſes all its activity. The author afterwards makes this reflection on this ſingular machine :

" If, ſays he, I had ſeen the animalculæ pretended to be in the ſemen of living animals, perhaps I might be in a condition to determine whether they are really living creatures, or ſimple machines prodigiouſly minute, and which are in miniature, what the veſſels in the calmar are in the great."

By this and ſome other analogies Mr. Needham concludes, there is a great appearance that the ſpermatic worms of other animals are only organized bodies and machines, like to thoſe of the calmar, whoſe actions are made at different times ; " for, ſays he, let us ſuppoſe, that in the prodigious number of ſpermatic worms ſeen on the table of a microſcope, there are ſome thouſands which act at the ſame time, that will be ſufficient to ſhew us they are all alive. Let us alſo conceive, adds he, that the motion of theſe ſpermatic worms remains, like that of the machines of the calmar about half a minute; then the ſucceſſion of action of theſe ſmall machines will remain a long time, and the pretended animals will appear to decreaſe ſucceſſively. Beſides, why ſhould the calmar alone have machines in its ſeed, whereas every other animal has ſpermatic worms, and real animals? Analogy is here of ſuch great weight, that it does not appear poſſible to refuſe it." Mr. Needham likewiſe very juſtly remarks, that even the obſervations of Leeuwenhoek ſeems to indicate that the ſpermatic worms have a great reſemblance with the organized bodies in the ſeed of the calmar. "I have, ſays Leeuwenhoek, ſpeaking of the cod, taken thoſe real ſubſtances for hollow and extended animalculæ, becauſe they were four times as large as the living animalculæ." And in another part "I have remarked, he ſays, ſpeaking of the ſeed of a dog, that the animalcules often change their form, eſpecially when the liquor in which they float, evaporates. Their progreſſive motion does not extend above the diameter of an hair *.

After conſidering all theſe circumſtances Mr. Needham conjectures, that the ſuppoſed ſpermatic animals might poſſibly be only natural machines, ſubſtances much more ſimply organized than the bodies of animals. I have ſeen with his microſcope theſe machines in the calmar, and the deſcription he gives of them is very faithful and exact. His obſervations then ſhew us, that the ſeminal liquor is compoſed of parts which ſeek to be organized; that it in fact produces organized ſubſtances, but that they are not as yet either animals or organized ſubſtances, like the individual which produced them. We might ſuppoſe that theſe ſubſtances are only inſtruments which ſerve to perfect the ſeminal liquor, and ſtrongly impel it; and that it is by their briſk and internal action that it moſt intimately penetrates the ſeminal liquor of the female.

---

* See Leeuwenh. Arch. Nat. page 306, 309, 310.

CHAPTER VII.

COMPARISON OF MY OBSERVATIONS WITH THOSE OF LEEUWENHOEK.

ALTHOUGH I made the preceding experiments with all the circumſpection poſſible; and although I repeated them a number of times, I am perſuaded that many things eſcaped my notice; I have only related what I ſaw, and what all the world may ſee, with a little art and much practice. In order to be free from prejudices, I endeavoured to forget what other naturaliſts aſſerted to have ſeen, conceiving that by ſo doing I ſhould be more certain of only ſeeing in fact what really appeared;

peared; and it was not till after I had digeſted my obſervations, that I compared them with thoſe of Leeuwenhoek, &c. I by no means pretend to have greater abilities in microſcopical obſervations than that great naturaliſt, who paſſed more than ſixty years in making various experiments.

Notwithſtanding the authority his obſervations may juſtly claim, it is ſurely permitted to examine and compare others with them. Truth can only be gained by ſuch examinations, and errors diſcovered, particularly as we do it without any partiality, and in the ſole view of eſtabliſhing ſomething fixed and certain on the nature of thoſe moving bodies ſeen in the ſeminal liquors.

In November 1677, Leeuwenhoek, who had already communicated to the Royal Society of London many microſcopical obſervations on the optic nerve, the blood, the juice of the plants, the texture of trees, rain-water, &c. addreſſed to Lord Brouncker, Preſident of the Society, in the following words:— "Poſtquam Exc. * &c. Dominus Profeſſor Cranen me viſitatione ſua ſæpius honorarat, litteris rogavis, Domino Ham concrato ſuo, quaſdam

---

[*] See Phil. Tranſ. No. 141, page 1041.

quaſdam obſervationum mearum, videndas darem. Hic dominus Ham me ſecundo inviſens, ſecum in laguncula, vitrea ſemen viri, gonorrhæa laborantis, ſponte deſtillatum, attulit, dicens, ſe poſt pauciſſimas temporis minutias (cum materia illa jam in tantum eſſet reſoluta ut fiſtulæ vitreæ immitti poſſet) animalcula viva in eo obſervaſſe, quæ caudam & ultra 24 horas non viventia judicabat; idem referebat ſe animalcula obſervaſſe mortua poſt ſumptam ab ægroto therebintinam. Materiam prædicatam fiſtulæ vitreæ immiſſam, præſente Domino Ham, obſervavi, quaſdamque in ea creaturas viventes, at poſt decurſum 2 aut 3 horarum eamdem ſolus materiam obſervans, mortuas vidi.

" Eamdem materiam (ſemen virile) non ægroti alicujus, non diuturna conſervatione corruptam, vel poſt aliquot momenta fluidiorem factam, ſed ſani viri ſtatim poſt ejectionem, ne interlabentibus quidem ſex arteriæ pulſibus, ſæpiuſcule obſervavi, tantamque in ea viventium animalculorum multitudinem vidi, ut interdum plura quam 1000 in magnitudine aræne ſeſe moverent; non in toto ſemine, ſed in materia fluida craſſiori adhærente, ingentem illam animalculorum multitudinem obſervavi; in craſſiori vero ſeminis materia quaſi ſine motu jacebant, quod inde provenire mihi imaginabar, quod materia illa craſſa ex tam variis cohæreat partibus, ut animalcula in ea ſe movere nequirent; minora globulis ſanguini ruborem adferentibus hæc animalcula erant, ut judicem, millena millia arenam grandiorem magnitudine non æquatura. Corpora eorum rotunda, anteriora obtuſa, poſteriora ferme in aculeum deſinentia habebant; cauda tenui longitudine corpus quinquies ſexieſve excedente, & pellucida craſſitiem vero ad 25 partem corporis habente prædita erant, adeo ut ea quoad figuram cum cyclaminis minoribus, longam caudam habentibus, optime, comparare queam; motu caudæ ſerpentino, aut ut anguillæ in aqua natantis progrediebantur; in materia vero aliquantulum craſſiori caudam octies decieſve quidem evibrabant antequam latitudinem capilli procedebant. Interdum mihi imaginabar me internoſcere poſſe adhuc varias in corpore horum animalculorum partes, quia vero continuo eas videre nequibam, de iis tacebo. His animalculis minora adhuc animalcula, quibus non niſi globuli figuram attribuere poſſum, permiſſa erant.

“ Memini me ante tres aut quatuor annos, rogatu Domini Oldenburg, B. M. ſemen virile obſervaſſe, & prædicta animalia pro globulis habuiſſe ; ſed quia faſtidiebam ab ulteriori inquiſitione, & magis quidem a deſcriptione, tunc temporis eam omiſi. Jam quoad partes ipſas, ex quibus craſſam ſeminis materiam, quoad majorem ſui partem conſiſtere ſæpius cum admiratione obſervavi, ea ſunt tam varia ac multa vaſa, imo in tanta multitudine hæc vaſa vidi, ut credam me in unica ſeminis gutta plura obſervaſſe quam anatomico per integrum diem ſubjectum aliquod ſecanti occurrant. Quibi viſis, firmiter credebam nulla in corpore humano jam formato eſſe vaſa, quæ in ſemine virili bene conſtituto non reperiantur. Cum materia hæc per momenta quædam aëri fuiſſet expoſita, prædicta vaſorum multitudo in aquoſam magnis oleaginoſis globulis permiſtam materiam mutabatur, &c.”

The Secretary of the Royal Society, in anſwer to this letter, ſays, that it would be proper to make the like experiments on the ſeed of other animals, as dogs, horſes, &c. not only to form a better judgment on the firſt diſcovery, but to know the differences which

might be found in the number, and the figure of thoſe animalcules. And with relation to the veſſels of the thickeſt part of the ſeminal liquors, he greatly doubts they were only filaments without any organization, “ quæ tibi videbatur vaſorem congeries, fortaſſis ſeminis ſunt quædam filamenta, haud organice conſtructa, ſed dum permearunt vaſa generationi inſervientia in iſtiuſmodi figuram elongatā. Non diſſimili modo ac ſæpius notatus ſum ſalivam craſſiorem ex glandularum faucium foraminibus editam quaſi e convolutis fibrilis conſtantem *.”

Leeuwenhoek anſwered him on the 18th of March, 1678, in the following words: “ Si quando canes coeunt marem a fœmina ſtatim ſeponas materia quædam tenuis & aquoſa (lympha ſcilicet ſpermatica) e pene ſolet paulatim exſtillare; hanc materiam numeroſiſſimis animalculis repletam aliquoties vidi, eorum magnitudine quæ in ſemine virili conſpiciuntur, quibus particulæ globulares aliquot quinquagies majores permiſcebantur.

“ Quod ad vaſorem in craſſiori ſeminis virilis portione ſpectabilium obſervationem attinet,

---

* See the Secretary's anſwer to Leeuwenhoek's Letter in the Phil. Tranſ. No. 141, page 1043.

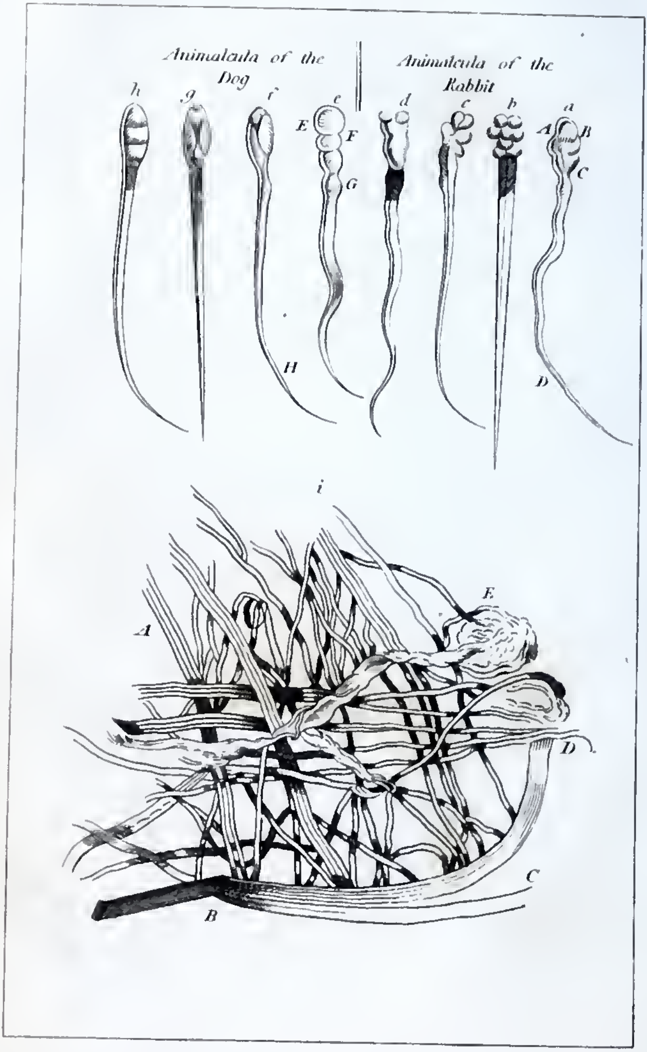
net, denuo non ſemel iteratam, ſaltem mihimetipſi comprobaſſe videor; meque omnino perſuaſum habeo, cuniculi, canis, felis, arterias venaſve fuiſſe a peritiſſimo anatomico haud unquam magis perſpicue obſervatas, quam mihi vaſa in ſemini virili, ope perſpicilli, in confectum venere.

" Cum mihi prædicta vaſa primum innotuere, ſtatim etiam pituitam, tum & ſalivam perſpicillo applicavi; verum hic minime exiſtentia animalia fruſtra quæſivi.

" A cuniculorem coitu lymphæ ſpermaticæ guttulam, unam & alteram, e femella exſtillantem, examini ſubjeci, ubi animalia prædictorum ſimilia, ſed longe pauciora, comparuere. Globuli item quam plurimi, plerique magnitudine animalium, iiſdem permiſti ſunt.

" Horum animalium aliquot etiam delineationes tranſmiſs, figura *a* (*plate* 3.) exprimit eorum aliquot vivum (in ſemini cuniculi arbitror) eaque forma qua videbatur, dum aſpicientem me verſus tendit. A B C, capitulum cum trunco indicant; C D, ejuſdem caudam, quam pariter ut ſuam anguilla inter natandum vibrat. Horum millena millia, quantum conjectare eſt, arenulæ majoris molem vix ſuperant,

PLATE. III.


Animalcula of the Dog
Animalcula of the Rabbit
h
g
f
e
E
F
G
H
d
c
b
a
A
B
C
D
i
A
E
D
C
B

rant, (*fig. b, c, d,*) ſunt ejuſdem generis animalia, ſed jam mortua.

" (*Fig. e.*) delineatur vivum animalculum, quemadmodum in ſemine canino ſeſe aliquoties mihi attentius intuenti exhibuit. E F G, caput cum trunco indigitant, G H, ejuſdem caudam, (*fig. f, g, h,*) alia ſunt in ſemine canino quæ motu & vita privantur, qualiam etiam vivorum numerum adeo ingentem vidi, ut judicarem portionem ſymphæ ſpermaticæ arenulæ mediocri reſpondentem, eorum ut minimum decena millia continere."

By another letter written to the Royal Society, the 31ſt of May, 1678, Leeuwenhoek adds, " Seminis canini tantillum microſcopio applicatum iterum contemplatus ſum, in eoque antea deſcripta animalia numeroſiſſime conſpexi. Aqua pluvialis pari quantitate adjecta, iiſdem confeſtim mortem accercit. Ejuſdem ſeminis canini portiuncula in vitreo tubulo unciæ partem duodecimalem craſſo ſervata, ſex & triginta horarum ſpatio contenta animalia vita deſtitua pleraque, reliqua moribunda videbantur.

" Quo de vaſorum in ſemine genitali exiſtentia magis conſtaret, delineationem eorum aliqualem mitto, ut in figura A B C D E, (*fig. i.*)

quibus literis circumſcriptum ſpatium arenulam mediocrem vix ſuperat ſuperat."

I have copied theſe firſt remarks of Leeuwenhoek from the Philoſophical Tranſactions, becauſe, in matters of this kind, obſervations made without any ſyſtematical view are thoſe which are the moſt faithfully deſcribed, and even this able naturaliſt no ſooner formed a ſyſtem on ſpermatic animals, than he began to vary in eſſential points.

It is evident by the above dates, that Hartſoeker is not the firſt who publiſhed, if he was the firſt who diſcovered ſpermatic animals. In the Journal des Sçavans, in the year 1774, there is a letter from Mr. Huguens, on the ſubject of a microſcope, made by one ſmall ball of glaſs, with which he aſſerts he perceived animals in the water, wherein pepper had been infuſed for two or three days, as Leeuwenhoek before had obſerved with the like microſcopes, but whoſe balls were not ſo minute. "There are alſo other ſeeds, he continues, which engender ſuch animals, as coriander ſeeds, &c. and I have ſeen the ſame thing in the pith of the birch tree, after having kept it for four or five days; and ſome have obſerved them in the water where nutmegs and cinnamon have been ſoaked. Theſe animals may be ſaid to engender from ſome corruption or fermentation: but there are others which muſt have a different origin; as thoſe in the ſeed of animals, which ſeem in ſuch great numbers, as to be almoſt compoſed of them; they are all tranſparent, have a quick motion, and their figures are like the tadpole."

Huguens does not mention the author of this diſcovery; but in the Journal of the 29th of Auguſt in the ſame year, there is an extract of a letter of M. Hartſoeker, in which he gives the method of forming theſe glaſs balls by means of the flame of a lamp; and the author of the Journal ſays, "By this method he has diſcovered that little animals are engendered in urine which has been kept for ſome days, and have the figure of little eels: he found ſome in the ſeed of a cock, which appeared of the ſame form, but quite different from thoſe found in the ſeed of other animals, which reſemble tadpoles, or young frogs, before their legs are formed." The author ſeems to attribute the invention to Hartſoeker; but if we reflect on the uncertain manner in which it is there repreſented, and on the particular manner which Leeuwenhoek ſpeaks in his letter, written and publiſhed above a year before, we muſt allow him to be the firſt who made this obſervation; but between them a conteſt took place as to the diſcovery which has never been decided. Be this as it will, Leeuwenhoek was undoubtedly the firſt inventor of the microſcope, whoſe focuſſes are balls of glaſs formed by the flame of a lamp. But to return to his obſervations.

I ſhall firſt remark, that what he ſays of the number and motion of theſe pretended animals is true; but the figure of the body is not always the ſame as he deſcribes it: ſometimes the part which precedes the tail is round and at others long; often flat, and frequently broader than it is long, &c. and with reſpect to the tail, it is often much larger and ſhorter than he aſſerts. The motion of vibrations which he gives to the tail, and by means of which he pretends that the animalcules advance progreſſively in this fluid, has never appeared to me as he has deſcribed it. I have ſeen theſe moving ſubſtances make eight or ten oſcillations from the right to the left, or vice verſa, without advancing the breadth of a hair; and I have even ſeen many more which could not advance at all; becauſe this tail, inſtead of being of any aſſiſtance to them,

them was, on the contrary, a thread attached either in the filaments or mucilaginous parts of the liquor, and rather retained the moving ſubſtance like as a thread faſtened to the point retains the ball of a pendulum; and when this tail had any motion, it only reſembled a thread which forms a curve at the end of an oſcillation. I have ſeen theſe threads, or tails, faſtened to the filaments which Leeuwenhoek ſtiles veſſels; I have ſeen them ſeparate after many reiterated efforts of the moving bodies; I have ſeen them at firſt lengthen, then diminiſh, and at laſt totally diſappear. I therefore think theſe tails ſhould be conſidered as accidental parts, and not as eſſential to the bodies of theſe pretended animals. But what is moſt remarkable, Leeuwenhoek preciſely ſays, in his letter to Lord Brouncker, that, beſides theſe animals that had tails, there were alſo ſmaller animals in this liquor, which had no other form than that of a globule. "Hic Animalculis (caudatis ſcilicet) minora ad huc Animalcula; quibus non niſi globuli figuram attribuere poſſum, permiſta erant." This is the truth; but after Leeuwenhoek had advanced that theſe animals were the only efficient principle of generation, and that they were transformed into human figures, he

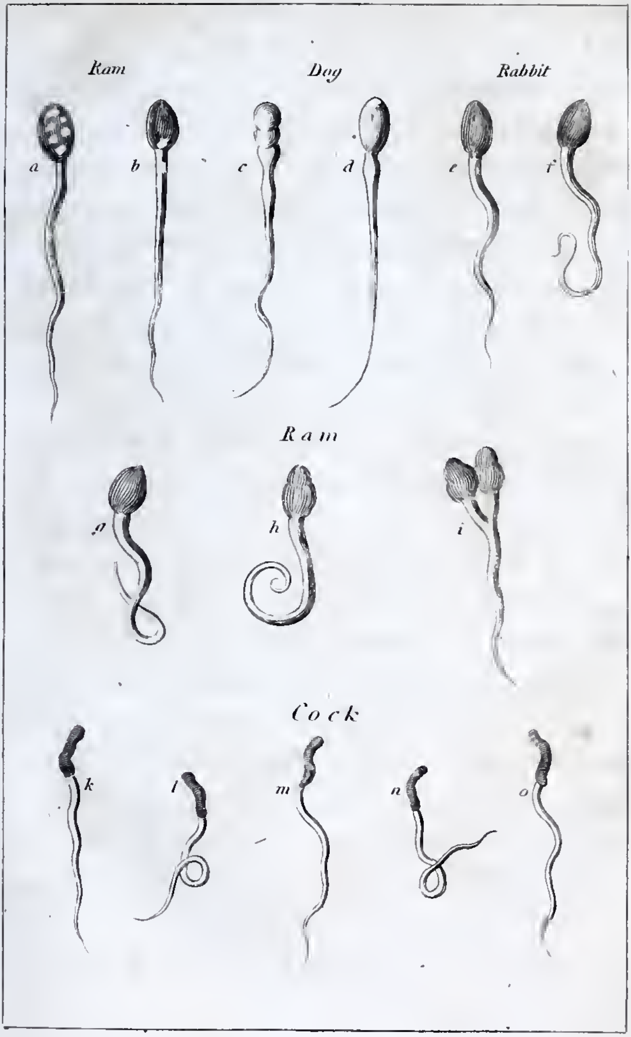
has

has only regarded thoſe as animals which had tails; and as it was conſiſtent for animals that were transformed into human figures, to have a conſtant form, he never afterwards mentions thoſe ſmaller animalcules without tails; and I was greatly ſurpriſed, on comparing the copy of this letter with that he publiſhed twenty years after, in his 3d volume, where, inſtead of the above words, the following are found: "Animalculis hiſce permiſtæ jacebant aliæ minutiores particulæ, quibus non aliam quam globulorum ſeu ſphæricam figuram aſſignare queo;" which is quite different. A particle of matter to which he attributes no motion, is very different from an animalcule: and it is aſtoniſhing that Leeuwenhoek, in copying his own works, has altered this eſſential article. What he adds immediately after likewiſe merits attention: he ſays, that by the deſire of Mr. Oldenburg he had examined this liquor three or four years before, when he took theſe animalcules for globules; that is, there are times when theſe pretended animalcules are no more than globules, without any remarkable motion, and others when they move with great activity; ſometimes they have tails, and at others they have none. Speaking in general of ſpermatic animals he ſays, "Ex hiſce meis obſervationibus cogitare cœpi, quamvis antehac de animalculis in ſeminibus maſculinis agens, ſcripſcerim me in illis caudas non detexiſſe, fieri tamen poſſe ut illa animalcula æque caudis fuerint inſtructa ac nunc comperi de animalculis in gallorum gallinaceorum emine maſculino;" another proof that he has often ſeen ſpermatic animals of all kinds without tails.

In the ſecond place we muſt remark, that the filaments which are ſeen in the ſeminal liquor before it is liquified were diſcovered by Leeuwenhoek, and that in his firſt obſervations, before he had made any hypotheſis on ſpermatic animals, he conſidered theſe filaments as veins, nerves, and arteries; and firmly believed all the parts and veſſels of the human body might clearly be ſeen in the ſeminal liquor. This opinion he perſiſted in, in defiance of the repreſentations which Oldenburg made to him on this ſubject from the Royal Society: but as ſoon as he thought of transforming theſe pretended ſpermatic animals into men, he no longer mentioned theſe veſſels; and inſtead of looking on them as nerves, arteries, and veins, of the human body already formed in the ſeed; he did not even attribute to them the functions they really poſſeſs, the producing of theſe moving bodies: and he ſays, vol. 1, p. 7, "Quid fiet de omnibus illis particulis ſeu corpuſculis præter illa animalcula ſemini virili hominum inhærentibus; olim & priuſquam hæc ſcriberem, in ea ſententia fui prædictas ſtrias vel vaſa ex teſticulis principium ſecum ducere, &c." And in another part he ſays, that if he had formerly written any thing on the ſubject of theſe veſſels found in the ſeed, we muſt pay no attention to it.

We ſhall obſerve in the third place, that if we compare the figures *a*, *b*, *c*, *d*, (PLATE III.) copied from the Philoſophical Tranſactions, with thoſe which Leeuwenhoek had engraved many years after, (PLATE IV.) we ſhall find conſiderable difference, eſpecially in the figures of the dead animals, of a rabbit and in thoſe of a dog, (which plate we have alſo copied for the ſatisfaction of our readers) from all which we may conclude, that Leeuwenhoek has not always obſerved objects entirely alive: that the moving bodies, which he looked upon as animals, appeared to him under different forms; and that he has varied in his aſſertions, with a view of making the ſpecies of men and animals perfectly conſiſtent; he has not only varied in the baſis of theſe experiments,

PLATE. IV.



experiments, but even in the manner of making them, for he expreſsly ſays, that he always diluted the liquor with water, in order to ſeparate, and to give more motion to theſe animalcules: nevertheleſs, in his letter to Lord Brouncker, he ſays, that having mingled an equal quantity of rain-water with the ſeminal liquor of a dog, in which he had before perceived an infinity of living animalcules, yet the mixing of this water killed them. The firſt experiment of Leeuwenhoek's therefore was made, like mine, without any mixture; and it even ſeems, that he was not of opinion to mix any water with the liquor till a long time after; becauſe he thought he had diſcovered, by his firſt eſſay, that water cauſed the death of the animalculæ; which however is not the fact. I think that the mixture of the water only diſſolves the filaments very ſuddenly; for I have ſeen but very few filaments in all the experiments I have made after mixing the water with the ſeminal liquor.

As ſoon as Leeuwenhoek was perſuaded that ſpermatic animals were transformed into men, and other animals, he imagined he ſaw two ſorts in the ſeminal liquor of every animal, the one male, and the other female; and this difference, according to him, ſerved not only for the generation of themſelves, but for the production of males and females, which was very difficult to conceive by a ſimple transformation. He ſpeaks of the male and female animalcule, in his letter printed in the Philoſophical Tranſactions, No. 145, and in many parts of his works*, but he does not deſcribe the difference of theſe male and female animalcules, and which in fact never exiſted but in his own imagination.

The famous Boerhaave having aſked Leeuwenhoek, if he had not obſerved in ſpermatic animals different degrees of growth and ſize? Leeuwenhoek anſwered, that having diſſected a rabbit, he obſerved in the ſemen an infinite number of living animals. "Incredibilem, ſays he, viventium animalculorum, numerum conſpexerunt, cum hæc animalcula ſcypho impoſita vitreo & illic emortua, in rariores ordines diſparaſſent, & per continuos aliquot dies ſæpius viſu examinaſſem, quædam ad juſtam magnatudinem nondum excreviſſe adverti. Ad hæc quaſdam obſervavi particulas perexiles & oblongas, alias aliis majores, &, quantum oculis apparobat, cauda deſtitutas; quas quidem particulas non niſi animalcula eſſe credidi, quæ ad

---

* See vol. I. page 163, and vol. III. page 101, of his works.

juſtam magnitudinem non excreviſſent*." Here then are animalcules of different ſizes; ſome with tails and others without, which much better agrees with my experiments, than with Leeuwenhoek's own ſyſtem. We differ only in one particular; he ſays, that thoſe without tails were young animalculæ, which were not arrived at their full growth; while I, on the contrary; have ſeen theſe pretended animals quit the filaments with tails or threads, and afterwards loſe them by degrees.

In the ſame letter to Boerhaave, he ſays, in the ſemen of a ram, he perceived animalcules following each other in ſwarms like a flock of ſheep. "A tribus circiter annis teſtes urietis, adhuc calentes, ad ædes meas deferri curaveram, cum igitur materiam ex epididymibus eductam, ope microſcopii contemplarer, non ſine ingenti voluptate advertebam animalcula omnia, quotquot innatabant ſemini maſculino, eundum natando curſum tenere, ita nimirum ut quo itinere priora prinatarent eodem poſteriora ſubſequerenter, adeo ut hiſce animalculis quaſis ſit ingenitum, quod oves factitare videmus, ſcilicet ut precedentium veſtigiis grex univerſus incedat." This obſervation, which Leeuwenhoek made in 1713; and which he looks upon as ſingular and novel, proves to me, that he had never examined the ſeminal liquors of animals with attention, at leaſt ſufficient to give very exact deſcriptions of them. Leeuwenhoek was ſixty-one years old in 1713, had made microſcopical obſervations for more than forty-five years, had publiſhed the diſcovery of ſpermatic animals for about thirty-ſix years, and then, for the firſt time, ſaw in the ſeminal liquor of a ram, what is ſeen in all ſeminal liquors, and what I have deſcribed in Experiment IX. in the ſeed of a man; Experiment XII. in the ſeed of a dog; and in Experiment XXIX. in that of a bitch. It is not neceſſary to ſuppoſe the ſpermatic animals of the ram are endowed with inſtinct, to explain the floating of theſe animals, in flocks like ſheep, ſince thoſe of a man, dog, or bitch, does the ſame; and which motion depends ſolely on particular circumſtances, whoſe principle is, that all the fluid matter of the ſeed is on one ſide, while the thick matter is on the other; for then all the bodies in motion will be diſengaged from the mucilage, and follow the ſame road into the moſt fluid part of the liquor.

---

* See vol. IV. pages 280 and 281.

In another letter, written the ſame year, to Boerhaave, he relates ſome further obſervations he made on rams, and ſays, that he has ſeen in the *vaſa diferentia* flocks of animals which float all on one ſide, and others which go in a contrary direction ; and he adds, "Neque illud in unica epididymum parte, ſed & in aliis quas præcideram partibus, obſervavi. Ad hæc, in quadam paraſtatarum refecta portione complura vidi animalcula, quæ necdum in juſtam magnitudinem adoleverant, nam & corpuſcula illis exiliora & caudæ triplo breviores erant quam adultis. Ad hæc, caudus non habebant deſinentes in mucronem, quales tamen adultis eſſe paſſim comperio. Pæterea in quandam paraſtatarum portionem incidi, animalculis, quantum diſcernere potui, deſtitutam, tantum illi quædam perexiguæ inerant particulæ partim longiores, partim breviores, ſed altera ſui extremitate craſſiunculæ ; iſtas particulas in animalcula tranſituras eſſe non dubitabam." It is eaſy to ſee by this paſſage that Leeuwenhoek had ſeen in this ſeminal liquor what I found in all ; that is to ſay, moving bodies of different ſizes, figures, and motions ; and which agrees much better with the idea of organic particles in motion than of that with real animals.

It appears, therefore, that Leeuwenhoek's obſervations are not contrary to mine, although he has drawn very different concluſions from them. I am perſuaded that if any perſon would take the trouble of making the like experiments, they would not have any difficulty in diſcovering from whence theſe differences proceed, and would find that I have advanced nothing which is not conformable to truth; and to enable the reader to decide thereon, I ſhall ſubjoin a few remarks.

The filaments I have ſpoken of are not always to be perceived in the ſeminal liquor of a man. To diſcover them it muſt be examined the moment it is taken from the body, and even then it will ſometimes happen that there is not one to be ſeen. Sometimes the ſeminal liquor preſents, eſpecially when it is very thick, only large globules, which may be even diſtinguiſhed with a common lens. By inſpecting them with the microſcope they appear like young oranges; they are very opaque, and a ſingle one often fills up the whole table of the microſcope.. The firſt time I ſaw theſe globules I thought they were ſome foreign matters fallen into the liquor, but having examined different drops I diſcovered that the whole was compoſed of theſe thick globules. I ſelected one of the roundeſt, and whoſe ſize was ſuch, that its centre being in the middle of the table of the microſcope, I could at the ſame time obſerve the whole circumference; at firſt it was abſolutely opaque; a ſhort time afterwards I perceived a bright luminous ring to form on its ſurface, which remained about half an hour, and then approached by degrees towards the centre, which became clear, and of different colours, while the remainder of the globule continued opaque. This light, which brightened in the centre of the globule, reſembled thoſe ſeen in the great air bubbles. The globule then began to get a little flat, and acquire a ſmall degree of tranſparency. Having examined it more than three hours I perceived no more alteration, nor any appearance of motion, either internally or externally. I then imagined, that by mixing this liquor with water, theſe globules might be changed; in fact they did change, but they preſented only a tranſparent and homogeneous liquor, wherein was nothing remarkable. I ſuffered the ſeminal liquor to liquify of itſelf, and examined it at the end of ſix, twelve, and twenty-four hours, but ſaw nothing more than a fluid, without

out the ſmalleſt reſemblance of life or motion. I only relate this obſervation to ſhew that there are times when the common phenomena are not to be ſeen in the ſeminal liquor.

At times all the moving bodies appear to have tails, eſpecially in the ſemen of a man and a dog; the motion is then the leaſt briſk, and performed with difficulty. If this liquor is ſuffered to dry, the tails or threads are deprived of motion the firſt; the anterior extremity continues to vibrate for ſome time, and then all motion entirely ceaſes. Theſe ſubſtances may be preſerved in this ſtate of dryneſs for a long time, if a ſmall drop of water is mixed therewith, their figure changes, they are reduced into many globules, which ſometimes appear to be in motion, as well by their approximation to each other, as by the trepidation and twirling round their centres.

Theſe moving bodies in the ſeminal liquor of a man, dog, or bitch, ſo nearly reſemble each other, as to admit of miſtaking one for the other, eſpecially if they are examined the moment the liquor is drawn from the animal. Thoſe of the rabbit appear ſmaller and briſker; but thoſe differences proceed more from the different ſtates in which the liquor is at the time of obſervation, than from the nature of the liquor itſelf, which ought to be different in different kinds of animals; for example, in that of a man I have ſeen ſtreaks of thick filaments, (*fig.* 3.) and have perceived the moving bodies ſeparate themſelves from theſe filaments from whence they appeared to proceed; but I have never ſeen any thing like it in the ſemen of a dog; where, inſtead of filaments, or ſeparated ſtreaks, it is commonly a mucilage whoſe texture is more compact, and in which we with difficulty diſcern any filamentary parts; yet this mucilage gives birth to moving bodies like thoſe in the ſemen of a man.

The motions of theſe bodies remain a longer time in the liquor of a dog than in that of a man; from which it is more eaſy to be certain of the alteration of form above mentioned. The moment the liquor iſſues from the body of the animal we perceive the animalcules to have tails; in twelve, twenty-four, or thirty-ſix hours after, we ſhall find they have loſt thoſe tails, and are then no more than ovals in motion, often much briſker than at firſt.

The moving bodies are always a little below the ſurface of the liquor. On the ſurface ſome large tranſparent air bubbles, which have no motion, generally appear, though ſometimes theſe bubbles ſtir and ſeem to have a progreſſive motion, but which is nothing more than the agitation of the air. Below the moving ſubſtances we often ſee others much ſmaller, and which only appear like globules, having no tails, but the greateſt number of which are oftentimes in motion. I have alſo generally remarked, that in the infinite number of globules in all thoſe liquors, thoſe which are very ſmall are commonly black, or darker than the reſt; and that thoſe which are extremely minute and tranſparent, have but little or no motion; they appear alſo to weigh ſpecifically heavier, for they are always the deepeſt in the liquor.

CHAPTER XIII.

REFLECTIONS ON THE PRECEDING EXPERIMENTS.

BY the experiments we have juſt deſcribed, I was aſſured that females, as well as males, have a ſeminal liquor which contains moving ſubſtances; that theſe ſubſtances were not real animals, but only living organic particles; and that thoſe particles exiſt not only in the ſeminal liquors of the two ſexes, but even in the fleſh of animals, and in the germs of vegetables. To diſcover whether all the parts of animals, and all the germs of vegetables, contained living organic particles, I cauſed infuſions of the fleſh of different animals to be made, and of more than twenty kinds of ſeeds of different plants; and after they had infuſed four or five days, in phials cloſely ſtopt up, I had the ſatisfaction to ſee moving organic parts in them all; ſome appeared ſooner, and others later; ſome preſerved their motion for months together, while others were ſoon deprived of it; ſome directly produced large moving globules, that had the appearance of real animals, which changed their figures, ſeparated, and became ſucceſſively ſmaller; others produced only ſmall globules, whoſe motions were very briſk; others produced filaments which lengthened and ſeemed to vegetate, ſwelled, and afterwards thouſands of moving globules iſſued therefrom; but it is uſeleſs to detail my obſervations on the infuſion of plants, ſince Mr. Needham has publiſhed ſo excellent a treatiſe on the ſubject. I read the preceding treatiſe to that able naturaliſt, and often reaſoned with him on the ſubject, particularly on the probability that the germs of vegetables contained ſimilar moving bodies to thoſe in the ſeed of male and female animals. He thought thoſe views ſufficiently founded to deſerve to be purſued; and therefore began to make experiments on all parts of vegetables; and I muſt own that the ideas I gave him on this ſubject have reaped greater profit under his hands than they would have done from me. I could quote many examples, but ſhall confine myſelf to one, becauſe I indicated the circumſtance I am going to relate.

To determine whether the moving ſubſtances ſeen in the infuſions of fleſh were true animals, or only, as I ſuppoſed, moving organic particles, Mr. Needham imagined that he had only to examine ſome roaſted meat, becauſe if they were animals the fire muſt deſtroy them; and if not animals, they might ſtill be found there as well as when the meat was raw; having therefore taken the jelly of veal, and other roaſted meat, he infuſed them for ſeveral days in water, cloſely corked up in phials, and upon examination he found in every one of them a great quantity of moving ſubſtances. He ſhewed me ſome of theſe infuſions, and among the reſt that of the jelly of veal, in which there were moving ſubſtances, perfectly like thoſe in the ſeminal liquor of a man, a dog, and a bitch, when they have no threads, or tails; and although we perceived them to change their figures, their motions ſo perfectly reſembled thoſe of an animal which ſwims, that whoever ſaw them, without being acquainted with what has been already mentioned, might certainly have taken them for real animals. I ſhall only add, that Mr. Needham aſſured himſelf, by a multiplicity of experiments, that all parts of vegetables contain moving organic particles, which confirms what I have ſaid, and extends my theory on the compoſition of organized beings, and their reproduction.

All animals, both male and female, and all vegetables whatſoever, it is therefore evident are compoſed of living organic parts. Theſe organic parts are in the greateſt abundance in the ſeminal liquor of animals, and in ſeeds of vegetables. It is from the union of theſe organic parts returned from all parts of the animal or vegetable body, that reproduction is performed, and is always like the animal or vegetable in which it operates; becauſe the union of theſe organic parts cannot be made but by the means of an internal mould, in which the form of an animal or vegetable is produced. It is in this alſo the eſſence of the unity and continuity of the ſpecies conſiſts, and will ſo continue while the great Creator permits their exiſtence.

But before I draw general concluſions from the ſyſtem I am eſtabliſhing, I muſt endeavour to remove ſome objections which might be made, and mention ſome other circumſtances which will ſerve to place this matter in a better light.

It will be aſked, why I deny thoſe moving ſubſtances in the ſeminal liquors to be animals, ſince they have conſtantly been regarded as ſuch by Leeuwenhoek, and every other naturaliſt, who has examined them? I may alſo be told, that living organic particles are not perfectly intelligible, if they are to be looked upon as animalculæ; and to ſuppoſe an animal is compoſed of a number of ſmall animals, is nearly the ſame as ſaying that an organized being is compoſed of living organic particles. I ſhall therefore endeavour to anſwer theſe objections in a ſatisfactory manner.

It is certain that almoſt all naturaliſts agree in looking on the moving ſubſtances in ſeminal liquors as real animals; but it is no leſs certain, from my own obſervations, and thoſe of Mr. Needham, on the ſeed of the calmar, that theſe moving ſubſtances are more ſimple and leſs organized beings than animals.

The word *animal*, in the acceptation we commonly receive it, repreſents a general idea formed of particular ideas drawn from particular animals. All general ideas include many different ones, which approach, or are more or leſs diſtant from each other, and conſequently no general idea can either be exact or preciſe. The general idea which we form of an animal may be taken principally from the particular idea of a dog, a horſe, and other beaſts, which appear to us to act and move according to the impulſe of their will, and which are beſides compoſed of fleſh and blood, ſeek after their food, have ſexes, and the faculty of reproduction. The general idea, therefore, expreſſed by the word *animal*, muſt comprehend a number of particular ideas, not one of which conſtitutes the eſſence of the general idea, for there are animals which appear to have no reaſon, will, progreſſive motion, fleſh nor blood, and which only appear to be a congealed ſubſtance: there are ſome which cannot ſeek their food, but only receive it from the element they live in: there are ſome which have no ſenſation, not even that of feeling, at leaſt in any ſenſible degree: there are ſome have no ſexes, or are both in one; there only belongs, therefore, to the

the animal of a general idea what is common alſo to the vegetable, that is, the faculty of reproduction.

The general idea then is formed from the whole taken together, which whole being compoſed of different parts, there is conſequently between theſe parts degrees and links. An inſect, in this ſenſe, is ſomething leſs of an animal than a dog; an oyſter ſtill leſs than an inſect; a ſea-nettle, or a freſh-water polypus, ſtill leſs than an oyſter; and as nature acts by inſenſible links, we may find beings which are ſtill leſs animated than a ſea-nettle, or a polypus. Our general ideas are only artificial methods to collect a quantity of objects in the ſame point of view; and they have, like the artificial methods we ſhall ſpeak of, the defect of never being able to comprehend the whole. They are likewiſe oppoſite to the walk of nature, which is uniform, inſenſible, and always particular, inſomuch that by our endeavouring to comprehend too great a number of particular ideas in one ſingle word, we have no longer a clear idea of what that word conveys; becauſe, the word being received, we imagine that it is a line drawn between the productions of nature; that all above this line is *animal*, and all below it *vegetable* ; another word, as general as the firſt, and which is uſed as a line of ſeparation between organized bodies and inanimate matter. But as we have already ſaid, theſe lines of ſeparation do not exiſt in nature; there are beings which are neither animals, vegetables, nor minerals, and which we in vain might attempt to arrange with either. For example, when Mr. Trembly firſt obſerved the polypus, he employed a conſiderable time before he could determine whether it was an animal or a plant; and poſſibly from this reaſon that it is perhaps neither one nor the other, and all that can be ſaid is, that it approaches neareſt to an animal; and as we ſuppoſe every living thing muſt be either an animal or a plant, we do not credit the exiſtence of an organized being, that cannot be referred to one of thoſe general names; whereas there muſt, and in fact are, a great number of organized beings which are neither the one nor the other. The moving ſubſtances perceived in ſeminal liquors, in infuſions of the fleſh of animals, in ſeed, and other parts of plants, are all of this kind. We cannot call theſe animals, nor can we ſay they are vegetables, and certainly we can ſtill leſs aſſert they are minerals.

We can therefore affirm, without fear of advancing too much, that the grand diviſion of nature's productions into *Animals*, *Vegetables*, and *Minerals*, do not contain every material being; ſince there are ſome that exiſt which cannot be claſſed in this diviſion. We have already obſerved, that nature paſſes by inſenſible links from the animal to the vegetable, but from the vegetable to the mineral the paſſage is quick, and the diſtance conſiderable; from whence the law of nature's paſſing by imperceptible degrees appears untrue. This made me ſuppoſe that by examining nature cloſely we ſhall diſcover intermediate organized beings, which without having the power of reproduction, like animals and vegetables, would nevertheleſs have a kind of life and motion; other beings which, without being either vegetables or animals, might poſſibly enter into the compoſition of both, and likewiſe other beings which would be only the aſſemblage of the organic molecules I have ſpoken of in the preceding chapters.

In the firſt claſs of theſe kind of beings eggs muſt be placed; thoſe of hens, and other birds, are faſtened to a common pedicle, and draw their nouriſhment and growth from the body of the animal, but when faſtened to the ovary, they are not then real eggs, but only yellow globules which ſeparate from the ovary as ſoon as they have attained a certain growth. Their internal organization is ſuch that they derive nouriſhment from the lymph, the matrix of the hen, and by which they form the white membranes, and at laſt the ſhell. The egg therefore has a kind of life and organization, a growth, expanſion, and a form which it aſſumes by its own powers. It does not live like an animal, nor vegetate like a plant, nor is poſſeſſed of the power of reproduction; nevertheleſs it grows, acts externally, and is organized. Muſt we not then look upon it as a being of a ſeparate claſs, and which ought not to be ranked either with animal or mineral? for if it is pretended that the egg is only an animal production, deſtined for the nutriment of the chicken, and ſhould be looked upon as a part of the hen; I anſwer, that the eggs, whether impregnated or not, will be always organized after the ſame mode; that impregnation only changes an almoſt inviſible part; and that it attains its perfection and growth, as well externally as internally, whether it contains the chicken or not; and that conſequently it ought to be conſidered as a ſeparate being.

What I have ſaid will appear more clear, if we conſider the formation and growth of the eggs of fiſh; when the female depoſits them in the water they are only the outlines of eggs, which being ſeparated from the body of the animal, attract and appropriate to themſelves the particles which agree the beſt for their nouriſhment, and grow thus by intuſſuſception. In the ſame manner as the hen's egg acquires the white and membranes in the matrix, wherein it floats, ſo the eggs of fiſh acquire their membranes and white in the water; and whether the male impregnates them, by emitting on theſe the liquor of its roe, or whether they remain unimpregnated, they do not the leſs attain their entire perfection. It appears to me, therefore, that the eggs ſhould be conſidered as organized bodies, which being neither animals nor vegetables, are a genus apart.

A ſecond claſs of beings, of the ſame kind, are the organized bodies found in the ſemen of all animals, and which, like thoſe in the milt of a calmar, are rather natural machines than animals. Theſe are properly the firſt aſſemblages which reſult from the organic molecules we have ſo much ſpoken of, and they are, perhaps, the parts which conſtitute the organized bodies of animals. They are found in the ſemen of all animals, becauſe the ſemen is only the reſidue of the organic molecules that the animal takes in with its aliment, and which, as we have already obſerved, are thoſe parts moſt analogous to the animal itſelf, and moſt organic; it is thoſe particles which compoſe the matter of the ſemen, and conſequently we muſt not be aſtoniſhed to find organized bodies therein.

To be perfectly convinced that theſe organized bodies are not real animals, we need only reflect on the preceding experiments. The moving bodies in the ſeminal liquor have been taken for animals, becauſe they have a progreſſive motion, and are thought to have a tail; but if we conſider, on one hand, the nature of this progreſſive motion, which finiſhes in a very ſhort time without ever renewing its motion; and on the other, the nature of theſe tails, which are only threads that the moving bodies draw after them, we ſhall begin to heſitate; for an animal goes ſometimes ſlow, ſometimes faſt, and ſometimes remains in a ſtate of reſt; theſe moving bodies, on the contrary, always continue the ſame motion, and I have never ſeen them ſtop and renew their movement again. I aſk, whether this kind of continued motion, without any reſt, is common to animals, and if that ought not to make us doubt theſe moving bodies being real animals? An animal of any kind muſt alſo have a conſtant form and diſtinct limbs; but theſe moving bodies vary and change their forms every moment, have no diſtinct limbs, and their tails appear as a part which does not belong to the individual. Can we then imagine theſe bodies to be real animals? In ſeminal liquors filaments are ſeen which lengthen and appear to vegetate; after which they ſwell and produce moving bodies. Theſe filaments may be kinds of vegetables, but the moving bodies which ſpring from them cannot be animals, for a vegetable has never yet been ſeen to produce an animal. Theſe moving bodies are found in all vegetable and animal ſubſtances; they are not produced by the modes of generation, they have no uniformity of ſpecies, and therefore can neither be animals nor vegetables. They are to be met with in the fleſh of animals, and in the ſubſtance of vegetables, but are moſt numerous in their ſeeds; is it not therefore natural to regard them as living organic particles which compoſe the animal or vegetable; as particles which having motion and a kind of life, ought, by their union, to produce moving and living beings, and ſo form animals and vegetables?

But in order to leave this matter as little in doubt as poſſible, let us examine other ſubſtances. Can it be ſaid, the active machines which Mr. Needham perceived in the milt of the calmar were animals? Can it be thought that eggs, which are active machines of another kind, are alſo animals? If we turn our eyes to the repreſentation of almoſt all the moving bodies Leeuwenhoek ſaw in different matters, ſhall we not be convinced, even at the firſt inſpection, that thoſe bodies are not animals, ſince not one of them has any limbs, but are all either globular or oval? If we afterwards examine what this celebrated naturaliſt ſays, when he deſcribes the motion of theſe pretended animals, we can no longer doubt of his being in an error when he conſidered them as ſuch; and we ſhall be ſtill more and more confirmed that they are only moving organic particles by the following examples; Leeuwenhoek gives * the figure of the moving bodies which he obſerved in the liquor of a male frog. This figure only repreſents a ſlender body, long, and pointed at one of its extremities; and of this he ſays, "Uno tempore caput (thus he calls the thickeſt extremity of this moving body) craſſius mihi apparebat alio; plerumque agnoſcebam animalculum haud ulterius quam a capite ad medium corpus, ob caudæ tenuitatem, & cum idem animalculum paulo vehementius moveretur (quod tamen tarde fiebat) quaſi volumine quodam circa caput ferebatur. Corpus fere carebat motu; cauda tamen in tres quatuorve flexus volvebatur." This then is the change of form which I mentioned to have ſeen, the mucilage from which the moving bodies uſe all their efforts to be diſengaged, the ſlowneſs of their motion before they are diſengaged; and the animal, according to Leeuwenhoek, one part of which is in motion, and the other dead: for he afterwards ſays, "Movebant poſteriorem ſolum partem, quæ ultima, morti vicinia eſſe judicabam." All this does not agree with an animal, but with what I have ſpoken of; excepting that I never ſaw the tail move

---

* Vol. I. p. 51.

move but by the agitation of the body. He afterwards ſays, ſpeaking of the ſeminal liquor of a cod, " Non eſt putandum omnia animalcula in ſemine aſelli contenta uno eodemque tempore vivere, ſed illa potius tantum vivere quæ exitui ſeu partui viciniora ſunt, quæ & copioſiori humido innatant præ reliquis vita carentibus, adhuc in craſſa materia, quam humor eorum efficit, jacentibus."

If theſe are animals, why have they not all life? why are they in the moſt fluid part of the liquor alive, while thoſe in the thickeſt are not ſo? Leeuwenhoek did not perceive that the thick matter, the origin of which he attributes to the humour of the animalculæ, is nothing but a mucilaginous matter which produces them. By diluting this mucilage with water, he would have given life to the whole of them. Even this mucilage is oftentimes only a maſs of thoſe bodies which are ſet in motion on being ſeparated ; and conſequently this thick matter, inſtead of being a humour, produced by the animalcules, is only the ſubſtance of the animals themſelves, or rather, as we have already obſerved, the matter from which they originate. Speaking of the ſeed of a cock, Leeuwenhoek ſays, in his let-

ter to Grew, "Contemplando materiam (ſeminalem) animadverti ibidem tantam abundantiam viventium animalium, ut ea ſtuperem; forma ſeu externa figura ſua noſtrates anguillas fluviatiles referebant, vehementiſſima agitatione movebantur; quibus tamen ſubſtrati videbantur multi & admodum exiles globuli, item multæ plan-ovales figuræ, quibus etiam vita poſſet attribui, & quidem propter earumdem commotiones; ſed exiſtimabam omnes haſce commotiones & agitationes provenire ab animalcules, ſicque etiam res ſe habebat; attamen ego non opinione ſolum, ſed etiam ad veritatem mihi perſuadeo has particulas planam & ovalem figuram habentes, eſſe quædam animalcula inter ſe ordine ſuo diſpoſita & mixta vitaque adhuc carentia." Here we ſee in the ſame ſeminal liquor animalcules of different forms; and I am convinced, by my own experiments, that if Leeuwenhoek had cloſely obſerved theſe oval ſubſtances, he would have diſcovered that they moved by their own powers, and that conſequently they were as much alive as the reſt. This change perfectly coincides with what I have ſaid, that they are organic particles which take different forms, and not conſtant ſpecies of animals; for in the preſent caſe, if the bodies, which have the figure of an eel, are true ſpermatic animalcules, each deſtined to become a cock, which ſuppoſes a very perfect organization, and a very conſtant form, what will thoſe be which have an oval figure, and what end do they anſwer? He ſays indeed afterwards, that theſe ovals may be conceived to be the ſame animals, by ſuppoſing their bodies to be twiſted in a ſpiral form; but then how ſhall we conceive that an animal, whoſe body is conſtrained, can move without being extended? I maintain, therefore, that theſe oval ſubſtances are no other than the organic particles ſeparated from their threads, and that the eels were the ſeparated parts which dragged thoſe threads after them, as I have many times perceived in other ſeminal liquors.

Leeuwenhoek, who imagined all theſe moving bodies were animals, and eſtabliſhed a ſyſtem thereon; who alſo pretended, that ſpermatic animals muſt become men and animals, now ſuſpected they were only natural machines, or organic particles in motion; for he does not doubt theſe ſpermatic animals contained the great animal in miniature, he ſays, "Progeneratio animalis ex animalculo in ſeminibus maſculinis omni exceptione major eſt; nam etiamſi in animalculo ex ſemine maſculo unde ortum eſt, figuram animalis conſpicere nequeamus, attamen ſatis ſuperque certi eſſe poſſumus figuram animalis ex qua animal ortum eſt, in animalculo quod in ſemine maſculo reperitur, concluſam jacere ſive eſſe; & quanquam mihi ſæpius conſpectis animalculis in ſemine maſculo animalis, imaginatus fuerim me poſſe dicere, en ibi caput, en ibi humeros, en ibi femora; attamen eum ne minima quidem certitudine de iis judicium ferre potuerim, hucuſque certi quid ſtatuere ſuperſedeo, donec tale animal, cujus ſemina maſcula tam magna erunt, ut in iis figuram creaturæ ex qua provenit, agnoſcere queam, invenire ſecunda nobis concedat fortuna." This fortunate chance, which Leeuwenhoek deſires, preſented itſelf to Mr. Needham. Every part of the ſpermatic animals of the calmar are eaſy to be ſeen without a microſcope; but they are not young calmars, as Leeuwenhoek thinks, nor even animated, although they are in motion, but only machines which muſt be regarded as the firſt produce of the union of organic particles.

Although Leeuwenhoek had not ſuch an opportunity of undeceiving himſelf, he nevertheleſs had another phenomena which ought to have had that effect; for example, he had remarked that the ſpermatic animals of a dog often change their figures, eſpecially when the liquor was on the point of evaporating; that theſe pretended animals had a hole in the head when they were dead, and that this hole did not appear when they were alive; he had ſeen that the part which he looked upon as the head was full and plump when it was alive, and flaccid and flat when dead. All this ought to have led him to doubt whether theſe moving bodies were real animals; and conſider it as agreeing better with a machine, which empties itſelf like that of the calmar, than with a moving animal.

I have ſaid that theſe moving bodies, theſe organic particles, do not move like animals, nor have an interval of reſt. Leeuwenhoek has obſerved the ſame: "Quotieſcunque, ſays he, animalcula in ſemine maſculo animalium fuerim contemplatus, attamen illa ſe unquam ad quietem contuliſſe, me nunquam vidiſſe, mihi dicendum eſt, ſi modo ſat fluidæ ſupereſſet materiæ in qua ſeſe commode movere poterant; et eadem in continuo manent motu, & tempore quo ipſis moriendum appropinquante, motus magis magiſque deficit, uſquedum nullus prorſus motus in illis agnoſcendus ſit." It appears difficult to conceive that animals can exiſt, from the moment of their birth till that of their death, in a continual rapid motion without the leaſt interval of reſt; and I cannot poſſibly imagine how theſe animals in the ſemen of a dog, which Leeuwenhoek ſaw the ſeventh day in as rapid motion as they were when they were firſt taken from the body of the animal, preſerved a motion during that time ſo exceedingly ſwift, that no animal has ſufficient power to move in for an hour; eſpecially if we conſider the reſiſtance which proceeds from the denſity and the tenacity of the liquor. This kind of continued motion, on the contrary, agrees with the organic particles, which, like artificial machines, produce their effects in a continual operation, and which ſtop when that effect is over.

Among the great number of Leeuwenhoek's experiments, he, without doubt, often perceived ſpermatic animals without tails; and he endeavours to explain this phenomena by a ſuppoſition; for example, he ſays, ſpeaking of the ſemen of a cod, "Ubi vero ad lactum accederem obſervationem, in iis partibus quas animalcula eſſe cenſebam neque vitam neque caudam dignoſcere potui; cujus rei rationem eſſe exiſtimabam, quod quamdiu animalcula natando loca ſua perfecte mutare non poſſunt tam diu etiam cauda concinne circa corpus maneat ordinata, quodque ido ſingula animalcula rotundum repræſentent corpuſculorem."

It would have been better to have ſaid, as it in fact is, that the ſpermatic animals of theſe fiſh have tails at certain times and none at others, than to ſuppoſe their tails twiſted ſo exactly round their bodies as to give them the ſhape of a globule. But this muſt not lead us to think that Leeuwenhoek only attended to the moving bodies which he ſaw with tails, but rather that he did not deſcribe the others, becauſe, although they were in motion, he did not regard them as animals; and this is the cauſe that all the ſpermatic animals he has depicted reſemble each other, and drawn with tails, ſince he only took them for real animals in that ſtate; and that when he ſaw them under other forms, he thought them imperfect

perfect, or rather that they were dead. On the whole it appears, by my experiments, that far from diſplaying their tails the more as they are in a more perfect condition of ſwimming, as Leeuwenhoek ſays, they, on the contrary, loſe their tails in a gradual manner, till at laſt theſe tails, which are no more than foreign bodies of the animalcules, and which they drag after them, entirely diſappear.

In another part Leeuwenhoek, ſpeaking of the ſpermatic animals of man, ſays, "Aliquando etiam animadverti inter animalcula particulas quaſdam minores & ſubrotundas; cum vero ſe ea aliquoties eo modo oculis meis exhibuerint, ut mihi imaginarer eas exiguis inſtructas eſſe caudis, cogitare cœpi annon hæ forte particulæ forent animalcula recens nata; certum enim mihi eſt ea etiam animalcula per generationem provenire, vel ex mole minuſcula ad adultam procedere quantitatem: & quis cit annon ea animalcula, ubi moriuntur, aliorum animalculorum nutritioni atque augmini inſerviant!" By this paſſage it appears that Leeuwenhoek had ſeen animals without tails in the ſeminal liquor of a man, and that he is obliged to ſuppoſe them to be juſt born, and not adult; but I have obſerved quite the contrary; for the moving bodies are never larger than when they ſeparate from the filaments, and begin to move. When they are entirely diſengaged from the mucilage they become ſmaller and continue decreaſing as long as they remain in motion. With reſpect to the generation of theſe animals, which Leeuwenhoek ſpeaks of as certain, I am perſuaded no ſign of generation has ever been diſcovered; all he ſays is advanced on mere ſuppoſitions, which it is eaſy to prove by his own obſervations; for example. he ſays that the milt of certain fiſh, as the cod, fills by degrees with ſeminal liquor, which after the fiſh has emitted, the milt dries up, leaving only a membrane deſtitute of any liquor." "Eo tempore, ſays he, quo aſcellus major lactes ſuos emiſit, rugæ illæ, ſeu tortiles lactium partes, uſque adeo contrahuntur, ut nihil præter pelliculas ſeu membranæ eſſe videantur." How then does he underſtand that this dry membrane, in which there is no longer either ſeminal liquor or animalcules, can reproduce animals of the ſame kind the ſucceeding year; if there was a regular generation in theſe animals, there could not be this interruption, which in moſt fiſhes laſts for a whole year. To draw himſelf out of this difficulty, he ſays, "Neceſſario ſtatuendum erit, ut aſcellus major ſemen ſuum emiſerit, in lactibus etiamnum multum materiæ ſeminalis gignendis animalculis aptæ remanſiſſe, ex qua materia plura oportet provenire animalcula ſeminalia quam anno proxime elapſo emiſſa fuerant." This ſuppoſition, that there remains ſomething in the ſeminal liquor in the milts to produce ſpermatic animals for the ſucceeding year, is abſolutely contrary to obſervations, for the milt is in this interval only a thin and abſolutely dry membrane. But what reply can be made to a ſtill further oppoſition to this point, there being fiſh like the calmar, the ſeminal liquor of which is not only renewed every year, but even the reſervoir which contains it? Can it be ſaid, that there remains a ſeminal matter in the milt for the production of the animals for the ſucceeding year, when even the milt does not remain? it is therefore very certain that theſe pretended ſpermatic animals are not multiplied, like other animals, by the mode of generation; which alone is ſufficient to make us preſume, that thoſe particles which move in the ſeminal liquors are not real animals. Thus Leeuwenhoek, who in the paſſage above quoted, ſays, it is certain that ſpermatic animals multiply and propagate by generation, nevertheleſs owns, in another

part,

obſcurity, and would, perhaps, perpetually have remained ſo, if the preceding experiments had not evinced that they are not animals, but moving organic particles contained in the nutriment the animal receives, and which are found in great numbers in the ſeminal liquor, which is the moſt pure, and in the moſt organic extracts drawn from this nutriment.

Leeuwenhoek acknowledges that he had not always found animalcules in the ſeminal liquor of males; in that of the cock, for example, which he had often examined, he ſaw ſpermatic animals in the form of eels but once, and ſome years after he could not diſcover any under that form, but obſerved ſome with large heads and tails, which his deſigner could not perceive. He ſays alſo, that one ſeaſon he could not find living animals in the ſeminal liquor of the cod. All theſe diſappointments proceeded from his deſire of finding tails to theſe animals; and although he perceived little bodies in motion, he did not conſider them as animals, becauſe they were without tails, notwithſtanding it is under that form they are generally ſeen, either in ſeminal liquors, or infuſions of animal or vegetable ſubſtances. He ſays, in the ſame place, that he was never able to make his deſigner perceive the ſpermatic animalcules of a cod, which he had ſo often ſeen himſelf,——"Non ſolum, ſays he, ob eximiam eorum exilitatem, ſed etiam quod eorum corpora adeo eſſent fragilia, ut corpuſcula paſſim dirumperentur; unde factum fuit ut nonniſi raro, nec ſine attentiſſima obſervatione, animadverterem particulas planas atque ovorum in morem longas, in quibus ex parte caudas dignoſcere licebat; particulas has oviformes exiſtimavi animalcula eſſe dirupta, quod particulæ hæ diruptæ quadruplo fere viderentur majores corporibus animalculorum vivorum." When an animal of any kind ceaſes to live, it does not then ſuddenly alter its form, and from being long, like a thread, becomes round like a ball; neither does it become four times larger after its death than it was before. Nothing that Leeuwenhoek ſays here agrees with the nature of animals; but, on the contrary, the whole correſponds with a kind of machine, which, like thoſe of a calmar, empty themſelves after having performed their functions. But let us purſue this obſervation; he ſays, he has ſeen the ſpermatic animals of the cod in different forms, "multa apparebant animalcula ſphæram pellucidam repreſentantia;" he has alſo ſeen them of different ſizes, "hæc animalcula minori videbantur mole, quam ubi eadem antehac in tubo vitreo rotundo examinaveram."

There needs nothing more to ſhew that there are no conſtant and uniform ſpecies of theſe animalcules; and that conſequently they are not animals, but only organic particles in motion, which, by their different combinations, take different forms and ſizes. Theſe organic moving particles are found in great quantities in the extract and reſidue of our nutriment. The matter which adheres to the teeth, and which in healthy people has the ſame ſmell as the ſeminal liquor, is only a reſidue of the food, and a great number of theſe pretended animals are alſo found there, ſome of which have tails, and reſemble thoſe in the ſeminal liquor. Mr. Baker had four different kinds of them engraved, and which were all of a cylindrical or oval make, or globules with and without tails. I am perſuaded, after having ſtrictly examined them, that not any of them are real animals, but are like thoſe in the ſeed, only living organical parts of the nutriment which preſent themſelves under different forms. Leeuwenhoek, who did not know how to account for theſe pretended animals in the matter which adhered to the teeth, ſuppoſed them to proceed from certain food they were previouſly in, as cheeſe, &c. but we find them among the teeth of thoſe who do not eat cheeſe, as well as in thoſe that do; beſides, they have not the leaſt reſemblance to mites, nor the other animalcules ſeen in rotten cheeſe. In another place he ſays, theſe animals of the teeth may proceed from the ciſtern water that is drank, beeauſe he obſerved animals like them in dew and rain water, eſpecially in that which ſtagnates upon lead or tiles; but with which we can prove there is not the leaſt reſemblance.

Moſt ſeminal liquors dilute of themſelves, and liquify when expoſed to the air or a certain degree of cold; but they thicken when a moderate degree of heat is communicated to them. I have expoſed ſome of theſe liquors to a very intenſe cold, as water on the point of freezing, but it did no injury to theſe ſuppoſed animals; they continued to move with the ſame ſwiftneſs, and as long as thoſe which had not been ſo expoſed, but thoſe which had ſuffered but a little warmth ſoon ceaſed to move, becauſe the liquor thickened. If the moving bodies were animals, they were of a complexion and temperament quite different from all others, to whom a gentle and moderate heat ſtrengthens their powers and motions, which the cold ſtops and deſtroys.

Notwithſtanding it may be thought I have dwelt too long upon this ſubject, I cannot conclude it without making one remark, from which ſome uſeful concluſions may be drawn. Theſe pretended ſpermatic animals, which are only living organic particles of the nutriment, not only exiſt in the ſeminal liquors of the two ſexes, and in the reſidue of the nutriment which adheres to the teeth, but alſo in the chyle and excrements. Leeuwenhoek having met with them in the excrements of frogs, and other animals, which he diſſected, was at firſt very much ſurpriſed, and not able to conceive from whence theſe animals proceeded, ſo entirely like thoſe he had obſerved in the ſeminal liquors, accuſes himſelf of having, in diſſecting the animal, opened the ſeminal veſſels, and that the ſeed had by that means been mixed with the excrements. But having afterwards found them in the excrements of other animals, and even in his own, he no longer knew to what to attribute them. Leeuwenhoek, it is worthy remark, never met with them in his own excrements, but when they were liquid. Every time he was diſordered and the ſtomach did not perform its functions, and was relaxed, he diſcovered theſe animalcules; but when the concoction of the food was well performed, and the excrement was hard, there was not a ſingle one, although it was diluted with water. This ſeems perfectly to agree with all we have before advanced: for when the ſtomach and inteſtines perform their functions, the excrements are only the groſſer parts of the nutriment; and all that is really nutritive and organic paſſes into the veſſels which ſerve to nouriſh the animal; whereas if the ſtomach and inteſtines are not in a condition to comminute the food, then it paſſes with the inanimate parts, and we find the living organic molecules in the excrements; from whence it may be concluded, that thoſe which are often lax muſt have leſs ſeminal liquor, and be leſs proper for generation, than thoſe of a different habit of body.

In all I have ſaid, I conſtantly ſuppoſed the female furniſhed a ſeminal liquor, which was as neceſſary to generation as that of the male. I have endeavoured to eſtabliſh in Chap. I. that animals, they were of a complexion and temperament quite different from all others, to whom a gentle and moderate heat ſtrengthens their powers and motions, which the cold ſtops and deſtroys.

Notwithſtanding it may be thought I have dwelt too long upon this ſubject, I cannot conclude it without making one remark, from which ſome uſeful concluſions may be drawn. Theſe pretended ſpermatic animals, which are only living organic particles of the nutriment, not only exiſt in the ſeminal liquors of the two ſexes, and in the reſidue of the nutriment which adheres to the teeth, but alſo in the chyle and excrements. Leeuwenhoek having met with them in the excrements of frogs, and other animals, which he diſſected, was at firſt very much ſurpriſed, and not able to conceive from whence theſe animals proceeded, ſo entirely like thoſe he had obſerved in the ſeminal liquors, accuſes himſelf of having, in diſſecting the animal, opened the ſeminal veſſels, and that the ſeed had by that means been mixed with the excrements. But having afterwards found them in the excrements of other animals, and even in his own, he no longer knew to what to attribute them. Leeuwenhoek, it is worthy remark, never met with them in his own excrements, but when they were liquid. Every time he was diſordered and the ſtomach did not perform its functions, and was relaxed, he diſcovered theſe animalcules; but when the concoction of the food was well performed, and the excrement was hard, there was not a ſingle one, although it was diluted with water. This ſeems perfectly to agree with all we have before advanced: for when the ſtomach and inteſtines perform their functions, the excrements are only the groſſer parts of the nutriment; and all that is really nutritive and organic paſſes into the veſſels which ſerve to nouriſh the animal; whereas if the ſtomach and inteſtines are not in a condition to comminute the food, then it paſſes with the inanimate parts, and we find the living organic molecules in the excrements; from whence it may be concluded, that thoſe which are often lax muſt have leſs ſeminal liquor, and be leſs proper for generation, than thoſe of a different habit of body.

In all I have ſaid, I conſtantly ſuppoſed the female furniſhed a ſeminal liquor, which was as neceſſary to generation as that of the male. I have endeavoured to eſtabliſh in Chap. I. that every organized body muſt contain living organic particles, and I have endeavoured to prove Chap. II. and III. that nutrition and reproduction operates by the ſame cauſe; that nutrition is made by the intimate penetration of theſe organic particles through each part of the body, and that reproduction operates by the ſuperfluity of theſe ſame organic particles collected together from all parts of the body and depoſited in appropriate reſervoirs. I have explained in Chap. IV. how this theory muſt be underſtood in the generation of man and animals which have ſexes. Females then being organized bodies like males, they muſt alſo have ſome reſervoirs for the ſuperfluity of organic particles returned from every part of their bodies. This ſuperfluity cannot come there through any other form than that of a liquor, ſince it is an extract of all parts of the body; and this liquor is that to which I have given the name of the female ſemen.

This liquor is not, as Ariſtotle pretends, an infecund matter of itſelf, which enters neither as matter nor form into the buſineſs of generation, but as eſſentially prolific as that of the male, containing characteriſtical parts of the feminine ſex, which the female alone can produce, the ſame as the male contains particles neceſſary to form the maſculine organs; and each of them contains every other organic particle that can be looked on as common to both ſexes; which cauſes that, by their mixture, the daughter may reſemble her father, and the ſon his mother. This ſemen Hippocrates ſays is compoſed of two liquors, the one ſtrong, for the production of males, and the other weak, for the production of females. But this ſuppoſition is too extended; I do not ſee how it is to be conceived that a liquor, which is the extract of every part of the female body, ſhould contain particles for the formation of the male organs.

This liquor muſt enter by ſome way into the matrix of animals which bear and nouriſh their fœtus within the body, and in others, as in oviparous animals, it muſt be abſorbed by the eggs; which may be looked upon as portable matrixes. Each of theſe matrixes contains a ſmall drop of this prolific liquor of the female, in the part that is called the *Cicatrice*. When there has been no communication with the male, this prolific drop collects under the form of a ſmall mole or maſs, as Malpighius obſerves; but when impregnated by that of the male, it produces a fœtus which receives its nutriment from the juices of the egg.

Eggs, inſtead of being parts generally found in every female, are therefore only inſtruments made uſe of by Nature to ſerve as the matrix in females which are deprived of that organ. Inſtead alſo of being active and eſſential to the firſt fecundation, they only ſerve as paſſive and accidental parts for the nutrition of the fœtus already formed by the mixture of the liquor of the two ſexes in a particular part of this matrix. Inſtead alſo of being exiſting bodies, incloſed, *ad infinitum*, one within the other, eggs, on the contrary, are bodies formed from the ſuperfluity of a more groſs and leſs organic part of the food than that which produces the ſeminal and prolific liquor; and are in oviparous females ſomething equivalent, not only to the matrix, but even to the menſtrua in the viviparous.

We ſhould be perfectly convinced that eggs are only deſtined by Nature to ſerve as a matrix in animals who have not that viſcera, by thoſe females producing eggs independent of the male. In the ſame manner as the matrix exiſts in viviparous animals, as a part appertaining to the female ſex, hens, who have no matrix, have eggs in their room, which are ſucceſſively produced of themſelves, and neceſſarily exiſt in the female independently of any communication with the male. To pretend that the fœtus is pre-exiſting in the eggs, and that theſe eggs are contained *ad infinitum* within each other, is nearly the ſame as to pretend that the fœtus is pre-exiſting in the matrix, and that the matrix of the firſt female incloſed all that ever were or will be produced.

Anatomiſts have taken the word *egg* in ſeveral acceptations and meanings. When Harvey took for his motto, *Omnio ex ovo*, he underſtood by the word egg, as applied to viviparous animals, the membrane which includes the fœtus and all its appendages: he thought he perceived this egg, or membrane, form immediately after the copulation of the male and the female. But this egg does not proceed from the ovarium of the female; and he has even maintained, that he did not remark the leaſt alteration in this teſticle, &c. We perceive there is here nothing like what is commonly underſtood by the word Egg, unleſs the figure of the bag may be ſuppoſed to have ſome reſemblance thereto. Harvey, who diſſected ſo many viviparous females, did not, he ſays, ever perceive any alteration in the ovaria; he looked on them even as ſmall glands, perfectly uſeleſs to generation*, altho' they undergo very remarkable changes and alterations in

---

* See Harvey Exercit, 64 and 65.

in them, ſince we may perceive in cows the glandular bodies grow from the ſize of a millet ſeed to that of a cherry. This great anatomiſt was led into this error by the ſmallneſs of the glandular bodies in the ſpecies of deer, to which he principally paid his attention. C. Peyerus, who alſo made many experiments on them, ſays, "Exigui quidem ſunt damarum teſticuli, ſed poſt coitum fœcundum, in alterutro eorum, papilla, ſive tuberculum fibroſum, ſemper ſuccreſcit; ſcroſis autem prægnantibus tanta accidit teſticulorum mutatio, ut mediocrem quoque attentionem fugere nequeat *" This author imagines, with ſome reaſon, that the minuteneſs of the teſticles of does, is the cauſe of Harvey's not having remarked the alterations; but he is wrong in advancing that the alterations he had remarked, and which had eſcaped Harvey's notice, did not happen till after impregnation.

It appears that Harvey was deceived in many other eſſential points; he aſſerts that the ſeed of the male does not enter into the matrix of the female, and even that it cannot; yet Verheyen found a great quantity of the male ſeed in the matrix of a cow, which he diſſected ſix hours after

---

[*] Vide Conradi Peyeri Merycologia.

after copulation [*]. The celebrated Ruyſch aſſerts, that having diſſected a woman who had been caught in the act of adultery, and was aſſaſſinated, he found, not only in the cavity of the matrix, but alſo in the trunks, a quantity of the ſeminal liquor of the male [†]. Valiſnieri affirms, that Fallopius and other anatomiſts had alſo diſcovered male ſeed in the matrix of many women. After the poſitive teſtimony of theſe great anatomiſts, there can remain no doubt but Harvey was deceived in this important point; eſpecially when to theſe are added that of Leeuwenhoek, who found the male ſeed in the matrix of a great number of females of different ſpecies.

Harvey makes another error in ſpeaking of an abortion in the ſecond month, where the maſs was as large as a pigeon's egg, but without any fœtus regularly formed; whereas it is maintained by Ruyſch, and many other anatomiſts, that the fœtus is perceptible, even to the naked eye, in the firſt month. The Hiſtory of the Academy mentions a fœtus, that was completely formed in twenty-one days after impregnation. If to theſe authorities we add that of Malpighius, who perceived the chicken in the cicatrice, immediately after the egg was laid by the hen, we cannot doubt but that the fœtus is formed immediately after copulation; conſequently we muſt not pay any credit to what Harvey ſays on the parts encreaſing one after the other by juxta-poſition, ſince they are all diſtant from the firſt, and gradually expand until the whole is complete.

---

[*] See Verheyen Sup. Anat. Tra. v. cap. III.

[†] See Ruyſch, Theſ. Anat. p. 90. tab. VI. fig. 1.

De Graaf took the acceptation of the word egg in a quite different light to Harvey: he inſiſts that the teſticles of women were true ovaries, and contain eggs like thoſe of oviparous animals, only that they are much ſmaller, do not quit the body, and are never detached till after impregnation, when they deſcend from the ovary into the horns of the matrix. The experiments of De Graaf have contributed moſt to eſtabliſh the exiſtence of theſe pretended eggs, which yet is not at all founded; for this famous anatomiſt is deceived, firſt by miſtaking the veſicles of the ovarium for eggs, whereas they are inſeparable from it, form parts of its ſubſtance, and are filled with a kind of lymph. Secondly, he is alſo deceived when he conſiders the glandular bodies to be the covering of thoſe eggs or veſicles; for it is certain, by Malpighius's, ghius's, Valiſnieri's, and my own obſervations, that the glandular bodies neither ſurround nor contain one of thoſe veſicles. Thirdly, he is deceived ſtill more when he ſuppoſes the glandular body is never formed till after fecundation; as they are invariably found in every female who has attained the age of puberty. Fourthly, he is no leſs deceived when he believes that the globules which he ſaw in the matrix, and which contained the fœtuſſes, were the ſame veſicles, or eggs, which had fallen from the ovarium, and which, he remarks, were become ten times ſmaller than they were in the ovary. This remark alone, one would imagine, ſhould have made him perceive his error. Fifthly, he is wrong in ſaying that the glandular bodies are only the coverings of the fecundated eggs, and that the number of coverings, or empty follicles, always anſwer to the number of fœtuſſes. This aſſertion is entirely contrary to truth; for on the teſticles of all females we find a greater number of glandular bodies, or cicatrices, than there are productions of fœtuſſes, and they are alſo found in thoſe which have never brought forth. To this we may add, that neither he, Verheyen, nor any other perſon, have ever ſeen theſe eggs, much leſs theſe pretended coverings, on which they have notwithſtanding eſtabliſhed their ſyſtem.

Malpighius, who perceived the growth of the glandular bodies in the female teſticles, was deceived when he thought he had ſeen the egg in their cavities, ſince they contain only liquor; nor indeed has any thing like an egg ever been diſcovered.

Valiſnieri, who was not deceived in facts, has yet drawn falſe concluſions in aſſerting, that although neither himſelf nor any anatomiſt in whom he could confide, ever found the egg in the cavity of the glandular body, yet it muſt there exiſt.

Let us, therefore, examine what may be fairly called the real diſcoveries of theſe naturaliſts. Graaf was the firſt who perceived there were alterations in the female teſticles; and he had reaſon to affirm, they were parts eſſential and neceſſary to generation. Malpighius demonſtrated that theſe alterations were occaſioned by the glandular bodies which grew to perfect maturity, afterwards they become flaccid, obliterated, and left only a ſlight cicatrice remaining. Valiſnieri has placed this diſcovery in a very clear light; he has ſhewn that theſe glandular bodies are found in the teſticles of every female; that they are augmented conſiderably in the ſeaſon of love, that they increaſe at the expence of the lymphatic veſicles of the teſticles, and that at the time of their maturity they were hollow and filled with liquor. This, then, is all that can be reduced to truth on the ſubject of the pretended ovaries and eggs of viviparous animals. What muſt we conclude therefrom? two things appear very evident; the one, that there does not exiſt any eggs in the female teſticles; the other, that there exiſts a liquor in the veſicles of the teſticle, and in the cavity of the glandular bodies. We have demonſtrated by the preceding experiments, that this laſt liquor is the true ſeed of the female, ſince it contains, like that of the male, ſpermatic animals, or rather organic moving particles.

We muſt therefore now be aſſured, that females have, as well as males, a ſeminal liquor. After all that has been advanced, we cannot doubt that the ſeminal liquor is the ſuperfluity of the organic nutriment, which is ſent back from all parts of the body into the teſticles and ſeminal veſicles of the males, and into the teſticles and glandular bodies of females. This liquor, which iſſues by the nipple of the glandular bodies, continually ſprinkles the horns of the matrix, and may eaſily procure admiſſion either by the ſuction of the membrane of theſe horns, or by the little opening which is at the upper extremity, and thus enter into the matrix; but in the ſuppoſition of theſe pretended eggs, which were ten or twenty times larger than the opening of the horns of the matrix, we cannot comprehend how they could enter therein.

The liquor emitted by females, when they are excited, and which, according to De Graaf, iſſues from the neck of the matrix, and the orifice of the urethra, may be a ſuperabundant portion of the ſeminal liquor which continually diſtils from the glandular bodies on the trunks of the matrix. But poſſibly this liquor may be a ſecretion of another kind, and perfectly uſeleſs in generation. To decide this queſtion obſervations with a microſcope are requiſite; but *all* experiments are not permitted even to philoſophers. I can only ſay, that I am inclined to believe that the ſame ſpermatic animals would be met with in this liquor as in that of the glandular bodies. I can quote an Italian doctor on this ſubject, who made this obſervation with attention, and which is thus related by Valiſnieri: "Aggiugne il lodato ſig. Bono d'avergli anco "veduti (animali ſpermatici) in queſta linfa o "ſiero, diro coſi voluttuoſo, che nel tempore "dell' amoroſa zuffa ſcappa dalle femine libidinoſe, ſenza che ſi poteſſe ſoſpetare che foſſero di que del' maſchio, &c." If this circumſtance is true, as I do not doubt, it is certain that this liquor is the ſame as that found in the glandular bodies, and that conſequently it is the true ſeminal liquor: and although anatomiſts have not diſcovered the communication between the vacuities of De Graaf and the teſticles, that does not prevent it, being once in the matrix, from iſſuing out by the vacuities about the exterior orifice of the urethra.

From hence we muſt conclude that the moſt abandoned women will be the leaſt fruitful, becauſe they emit that liquor which ought to remain in the matrix for the formation of the fœtus. Thus we ſee why common proſtitutes ſeldom have children, and why women in hot countries, where they have ſtronger deſires than in the cold, are much leſs fertile; but we ſhall have occaſion to ſpeak of this hereafter.

It is natural to think that the ſeminal liquor of the male or female would not be fertile but when it contains moving bodies; nevertheleſs that is ſtill a queſtion, and I ſhould be led to

think,

think, as there are different ſtates of this liquor, that in which theſe organic particles are ſeen in motion is not abſolutely neceſſary for the purpoſe of generation. The Italian phyſician above quoted never perceived ſpermatic animals in his ſemen till he had attained a middling age, although he was father of ſeveral children before, and continued to have them afterwards.

Theſe ſpermatic bodies, which move, may be looked upon as the firſt aſſemblages of the organic molecules which proceed from every part of the body; when a quantity of them collect they may be perceived with the microſcope; but if they collect only in a ſmall quantity the body which they form will be too minute to be perceived, and in this caſe we ſhall not be able to diſtinguiſh any of the ſeminal liquor. A very long continuation of obſervations would be neceſſary to determine what can be the cauſe of all the differences remarked in the ſtates of this liquor.

I can aſſert, from having often tried it, that by infuſing the ſeminal liquors in water cloſely corked, at the end of three or four days an infinite multitude of moving bodies will be found, although the ſeminal liquors had no motion on being firſt taken from the body of the animal. Fleſh, blood, chyle, urine, nay all animal or vegetable ſubſtances, contain organic particles, which move at the end of ſome days in an infuſion of water; they appear to act and move nearly in the ſame manner, and though produced from different bodies are perfectly ſimilar, without any of them having a power peculiar to themſelves. If theſe bodies muſt abſolutely be termed animals, it muſt be allowed they are ſo imperfect that they ought to be looked upon as the outlines of them, or rather as bodies ſimply compoſed of particles the moſt eſſential to the exiſtence of an animal; for natural machines, ſuch as thoſe found in the roe of a calmar, although they put themſelves in action at certain times, are certainly not animals, although they are organized, acting, and, as I may ſay, living beings.

If it is once allowed that the productions of Nature follow in an uniform order, and advance by imperceptible degrees and links, we ſhall have no difficulty in conceiving there are organic bodies exiſting, which belong neither to animals, vegetables, nor minerals.

It is certain, however, that all animals and vegetables contain an infinity of organic living molecules. Theſe molecules ſucceſſively take different forms, and different degrees of motion and activity, according to different circumſtances. They are in a much greater number in the ſeminal liquor of both ſexes, and in the germs of plants, than in other parts of the animal or vegetable. There exiſts then a living ſubſtance in animals and vegetables, common to both, and which ſubſtance is neceſſary to their nutrition. An animal procures nutriment from an animal or vegetable ſubſtance, and the vegetable can likewiſe be nouriſhed from an animal or vegetable in a decompoſed ſtate. This nutritive ſubſtance, common to both, is always living, always active, and produces an animal or vegetable, as it finds an internal mould or an analogous matrix, as we have explained in the firſt chapters; but when this active ſubſtance collects in great abundance in thoſe parts where it can unite, it forms in the animal body other living creatures, ſuch as the taper-worm, aſcarides, and worms, which are ſometimes found in the veins, in the ſinus of the brain, in the liver, &c. Theſe kinds of animals do not owe their exiſtence to the animals of the ſame ſpecies, and we may therefore ſuppoſe they are produced by this organic matter when it is extravaſated, or is too abundant for the lacteal veſſels to abſorb. We ſhall hereafter have occaſion to examine more largely the nature of thoſe worms, and many other animals which are formed in a ſimilar manner.

When this organic matter, which may be looked on as an univerſal ſeed, is collected in any great quantity, as in the ſeminal liquor, and in the mucilaginous parts of the infuſion of plants, its firſt effect is to vegetate, or rather to produce vegetating beings. Theſe zoophytes ſwell, extend, ramify, and produce globules, ovals, and other ſmall bodies, of different figures, which have all a kind of animal life, a progreſſive motion, which is often very ſwift, and ſometimes very ſlow. Theſe globules themſelves decompoſe, change their figures, and become ſmaller; and in proportion as they diminiſh in ſize the rapidity of their motion augments.

I have ſometimes thought that the venom of the viper, and other active poiſons, even that of the bite of a mad dog, might poſſibly be this active matter too rarefied; but I have not as yet had time to make the experiments which I had projected on this matter, as well as on drugs uſed in medicine; all that I can at preſent aſcertain is, that all infuſions of the moſt active drugs ſwarm with moving bodies, which form therein in much leſs time than in other ſubſtances.

Almoſt all microſcopic animals are of the ſame nature as the organized bodies which move in the ſeminal liquor, and in the infuſions of vegetables and the fleſh of animals; the eel-like bodies in flour, vinegar, and water, in which lead has been ſoaked, are beings of the ſame nature as the firſt, and have a like origin.

CHAPTER IX.

VARIETIES IN THE GENERATION OF ANIMALS.

THE matter which ſerves for the nutrition and reproduction of animals and vegetables is therefore the ſame; it is a productive and univerſal ſubſtance, compoſed of organic molecules, and whoſe union produces organized bodies. Nature always works on the ſame fund, which is inexhauſtible, but the means ſhe employs to ſtamp its value are different, and theſe differences, or general agreements, deſerve attention, becauſe it is from thence we muſt derive our reaſons to account for exceptions and particular varieties.

In general large animals are leſs productive than ſmall. The whale, elephant, rhinoceros, camel, horſe, the human ſpecies, &c. only produce one, and very ſeldom two, at a birth; whereas ſmall animals, as rats, herrings, inſects, &c. produce a great number at a time. Does not this difference proceed from there being more food required to ſupport a large body than to nouriſh a ſmall one, and from hence the former has leſs ſuperfluous organic particles, which would convert into ſemen, than the former? It is certain that ſmall animals eat more in proportion than large ones; but it is likewiſe probable that the prodigious multiplication of the ſmall animals, as bees, flies, and other inſects, may be attributed to their being endowed with very fine and ſlender limbs and organs, by which they are in a condition to chuſe what is moſt ſubſtantial and organic in the vegetable or animal matters from whence they derive their nutriment. A bee, who lives on the pureſt parts of flowers, certainly receives more organic particles in proportion than a horſe who feeds on the groſſer parts of vegetables, hay, &c. The horſe produces but one at one time, whereas the bee will bring forth three thouſand.

Oviparous animals are in general ſmaller than the viviparous, and produce alſo more at a birth. The duration of the fœtus in the matrix of viviparous animals likewiſe oppoſes their increaſe, nor can there be any new generation take place during geſtation, or while they are ſuckling their young, whereas oviparous animals produce at the ſame time both matrix and fœtuſſes, which they caſt out of the body, and are therefore almoſt always in a ſtate of reproduction; and it is well known that by preventing a hen from ſetting, and largely feeding, the number of her eggs will be conſiderably increaſed. If hens ceaſe to lay when they ſit it is becauſe they have ceaſed to feed; and it is the fear leſt their eggs ſhould not produce which cauſes them not to quit their neſts but once a day, and that for a very ſhort time, during which they take a little nutriment, but not one tenth part of what they take at other times.

Animals, which produce but a ſmall number at a time, acquire the chief part of their growth before they are fit for engendering, whereas thoſe which multiply numerouſly generate before they have received half their growth. The human ſpecies, the horſe, the aſs, the goat, and the ram, are not able to engender until they have obtained nearly the whole of their growth. It is the ſame with pigeons and other birds, who lay but a few eggs; but thoſe which produce in great numbers, as poultry, fiſh, &c. engender much ſooner. A cock is capable of engendering at the age of three months, when he has not attained a third part of his growth; a fiſh, which at the end of twenty years will weigh thirty pounds, engenders in the firſt or ſecond year, when perhaps it does not weigh half a pound. But exact obſervations on the growth and duration of the life of fiſh are ſtill wanting: their age may be nearly known by examining the annual layers of their ſcales; but we are not certain how far that may extend. I have ſeen carp in the Comte de Maurepas' canals, at his caſtle at Pont Chartrain, which were ſaid to be 150 years old, and they appeared as briſk and lively as the common carp. I will not ſay, with Leeuwenhoek, that fiſh are immortal, or at leaſt can never die with age; all muſt periſh in time, that is, all which have a beginning, a birth, muſt arrive to an end or death; but fiſh, living in an uniform element, and being ſheltered from the viciſſitudes and all the injuries of the air, muſt live a longer time in the ſame ſtate than other animals, eſpecially if theſe viciſſitudes of the air be, as a great philoſopher aſſerts, the principal cauſes of the deſtruction of living beings. But what muſt contribute to the long duration of their life is, that their bones are ſofter than thoſe of other animals, and do not harden with age. The bones of fiſh lengthen, and grow thick without taking any more ſolidity; whereas the bones of other animals continually increaſe in hardneſs and denſity, until at length, being abſolutely full, the motion of their fluid ceaſes, and death enſues. In their bones the repletion or obſtruction, which is the cauſe of natural death, is formed by ſuch ſlow and inſenſible degrees, that fiſh muſt require much time to arrive at what we call old age.

All quadrupeds covered with hair are viviparous; all thoſe covered with ſcales oviparous. May we not then believe that in oviparous quadrupeds, a much leſs waſte is made by tranſpiration, than the cloathing of ſcales retains; whereas in animals covered with hair this tranſpiration is more free and abundant? and is it not partly by this ſuperabundance of nutriment, which cannot be carried off by tranſpiration, that thoſe animals multiply ſo abundantly, and are enabled to go ſo long without food? All birds and all inſects that fly are oviparous, excepting ſome kinds of flies which bring forth their young alive. Theſe flies have no wings at their birth, but they ſhoot out and grow by degrees, and which they cannot uſe before they are at full growth. Scaly fiſh are likewiſe oviparous; as are all reptiles which have no legs, ſuch as ſnakes and different kinds of ſerpents; they change their ſkins which is compoſed of ſmall ſcales. The viper is only a ſlight exception to the general rule, for it is not truly viviparous, as it produces eggs, from which the young are hatched; it is certain this is performed in the body of the mother, who inſtead of caſting thoſe eggs, like other oviparous animals, ſhe retains and hatches them in her own body. The ſalamander, in which eggs and young ones are found at the ſame time, as obſerved by M. de Maupertuis, is an exception of the ſame kind in oviparous quadrupeds.

Moſt animals are perpetuated by copulation; yet many birds ſeem only ſtrongly to compreſs the females; indeed the oſtrich, crane, and ſome few others are ſo well ſupplied as to leave intromiſſion no ways equivocal. Male fiſh approach the female in the ſpawning time; they ſeem even to rub their bellies againſt each other, for the male often turns upon its back to meet the belly of the female; but the neceſſary part for copulation does not exiſt in them; and the male fiſh approaches the female only to emit the liquor in their milts on the eggs, which the female then depoſits; and it ſeems rather to be attracted by the eggs than the female; for when ſhe ceaſes throwing out the eggs, he inſtantly forſakes her, and with eagerneſs purſues the eggs, which the ſtream carries away, or that the wind diſperſes. Male fiſh may be ſeen to paſs and repaſs every ſpot where eggs are depoſited ſeveral times. It is certainly not for the love he bears the female that all theſe motions are made, becauſe it is not to be preſumed he always knows her; often being ſeen to emit his liquor on all eggs that he comes near, and that often before he has met with the female to which they belonged.

There are therefore animals, diſtinguiſhed by ſexes, which have proper parts for copulation, and ſome which are deficient in them; others, as ſnails, have both, and the two ſexes in the ſame individual; others, as vine-fretters, have no ſex, and engender in themſelves ſeparately; although they couple together when they pleaſe, we cannot determine whether that is a conjunction of ſexes; if it is ſo, we muſt ſuppoſe that Nature has included in this ſmall individual more faculties for generation than in any other kind of animal, and that it not only has the power of reproducing diſtinctly, but alſo the means of multiplying by the communication of another individual.

But whatever difference takes place in generation, Nature, by a new production, prepares the body for it, and which, whether manifeſted outwardly, or concealed internally, always precedes generation. The ovaries of oviparous animals, and the teſticles of female viviparous animals, before the ſeaſon of impregnation, experience a conſiderable change. Oviparous animals produce eggs, which at firſt are attached to the ovaries, by degrees they encreaſe in ſize, until they fall into the canal of the matrix, where they acquire their white, membranes, and ſhell. This production has marks of the fecundity of the female, and without which generation cannot be performed: ſo in viviparous females there are always one or more glandular bodies on the teſticles, which by degrees grow under the membrane that ſurrounds them; theſe glandular bodies enlarge and pierce, or rather impel and lift up the membrane of the teſticle; when their maturity is complete, a ſmall ſlit or ſeveral ſmall holes appear at their extremities, by which the ſeminal liquor eſcapes, and falls into the matrix: theſe glandular bodies are new productions that precede generation, and without which there would not be any.

In males there is alſo a ſimilar change which always precedes their capacity for generating. In oviparous animals a great quantity of liquor fills a conſiderable reſervoir, and which reſervoir itſelf is ſometimes formed every year; as in the calmar and ſome other fiſh. The teſticles of birds ſwell ſurpriſingly juſt preceding their amorous ſeaſon. In viviparous males, the teſticles alſo ſwell conſiderably in thoſe who have ſeaſons, and in general there is a ſwelling and an extenſion of the genital members in all ſpecies, which, although it be external, muſt be regarded as a new production neceſſarily preceding generation.

In the body of every animal, male or female, new productions are formed which precede generation; and when there is no real production there is always a ſwelling, and conſiderable extenſion in ſome of the parts. There are ſpecies in which this new production is not only manifeſt, but even the whole body ſeems to be renewed before generation can be performed; as is the caſe with inſects whoſe various metamorphoſes ſeem to be only for the purpoſe of generating; for the growth of the animal is completed before it is transformed. It ceaſes from taking nutriment, has no organs for generation, no means of converting the nutritive particles, of which they abound, into eggs or ſeminal liquor, and therefore this ſuperfluity unites and moulds itſelf at firſt into a form ſomething like that of the original. The caterpillar becomes a butterfly, becauſe, for theſe reaſons, it is unable to produce ſmall organized beings like itſelf; the organic particles, always active, take another form, by uniting, whoſe figure anſwers in part, and even in eſſential conſtitution to that of the caterpillar, but in which the organs of generation are developed, and may receive and tranſmit the organic particles of the nutriment which forms the eggs, and the individuals of the ſpecies. The individuals which proceed from the butterfly ought not to be butterflies, becauſe the nutriment, from whence the organic particles proceed, was taken while in the form of caterpillars; the produce therefore muſt be ſimilar, and not butterflies, which is only an occaſional production of the ſuperabundant nutriment; a method adapted by Nature to accompliſh the purpoſes of generation in theſe ſpecies, as by the glandular bodies and milts in other animals.

When the ſuperabundant quantity of organic nutriment is not great, as in man and moſt large animals, generation is not made till the growth of the animal is nearly complete, and then it is confined to the production of a ſmall number of individuals. When theſe particles are more abundant, as in many kinds of birds, and in oviparous fiſhes, generation is completed before the animal has received its full growth, and their production of individuals is very numerous. When the quantity of particles is ſtill greater, as in inſects, it firſt forms a large organic body, which, though retaining the eſſential conſtitution of its original, differs in many parts, as the butterfly from the caterpillar, but ſhortly produces an aſtoniſhing number of young, ſimilar in form to the animal which ſelected the nutriment. When the ſuperabundance is greater ſtill, and when at the ſame time the animal has the neceſſary organs for generation, as the vine-fretter, it immediately produces a generation in every individual, and afterwards a transformation, like other inſects. The vine-fretter becomes a fly, but cannot produce any thing, becauſe it is only the remainder of the organized particles which had not been made uſe of in the production of the young.

Almoſt every animal except man has ſtated times for generation. Spring is marked out for birds. Carp, and many kinds of fiſh, ſpawn in June and Auguſt. Barbel, and other kinds, in ſpring. Cats have three ſeaſons, in January, May, and September. Roebucks, in December. Wolves and Foxes, in January. Horſes in ſummer. Stags in September and October; and almoſt all inſects generate in autumn ; theſe laſt ſeem to be totally exhauſted by generation, and die a ſhort time after. Other animals, though not exhauſted, become extremely lean and very weak, and require a conſiderable time to repair the loſs which is made of the organic ſubſtance. Others are exhauſted ſtill leſs, and are ſoon reſtored to an engendering ſtate ; while man is ſcarcely in the leaſt affected ; his loſs is ſpeedily repaired, and therefore may be ſaid to be at all times in a ſtate for propagation ; all which depends ſolely on the particular conſtruction of the animal organs. The grand limits Nature has placed in the mode of exiſtence are equally conſpicuous in the manner of receiving and digeſting the food, in the manner of retaining it in or excluding it from the body, and in the means by which the organic molecules, neceſſary for reproduction, are extracted. In a word, we ſhall find throughout all nature, that all what can be, is.

The ſame difference exiſts in the time of female geſtation ; ſome, as mares, carry their young eleven or twelve months ; others, as women, cows, &c. nine months ; others, as foxes, wolves, &c. five months ; bitches, nine weeks ; cats, ſix weeks ; rabbits, thirty-one days. Moſt birds come out of the egg at the end of twenty-one days; though ſome, as canary birds, hatch in thirteen or fourteen days. The variety is as great here as in every thing elſe relative to animals. The largeſt animals which produce only few, are thoſe which go the longeſt with young; this ſtill more confirms what we have already ſaid, that the quantity of organic food is in proportion leſs in large than in ſmall animals; for it is from the ſuperfluity of the mother's food that the fœtus derives what is neceſſary to the growth and expanſion of its parts, and ſince this expanſion demands much more time in large than in ſmall animals, it is a proof that the quantity of matter which contributes is not ſo abundant in the firſt as in the laſt.

There is, therefore, an infinite variety in animals, with reſpect to the time and manner of geſtation, engendering, and bringing forth; and this variety is found even in the cauſes of generation; for although the general principle of production is this organic matter common to all that lives or vegetates, the manner in which the union is made, muſt have infinite combinations, which muſt all proceed from the ſource of new productions. My experiments clearly demonſtrate, that there are no pre-exiſting germs, and at the ſame time prove that the generation of animals and vegetables is not equivocal; there are, perhaps, as many beings, either living or vegetating, which are produced by the fortuitous aſſemblage of organic molecules, as by a conſtant and ſucceſſive generation. It is to thoſe productions we ſhould apply the axiom of the ancients, "Corruptio unius, generatio alterius." The corruption and compoſition of animals and vegetables produce an infinite number of organized bodies; ſome, as thoſe of the calmar, form only kinds of machines, which although very ſimple, are exceedingly active; others, as the ſpermatic animalcules, ſeem by their motion, to imitate animals; others imitate vegetables by their manner of growing and extending; there are others, as thoſe of blighted corn, which may be made to live and die alternately, and as often as we pleaſe; there are ſtill others, even in great quantities, which are at firſt kinds of vegetables, afterwards become ſpecies of animals, then return again to vegetables, and ſo on alternately. There is a great appearance, that the more we ſhall obſerve this race of organized beings, the more we ſhall diſcover varieties, always ſo much the more ſingular as they are the more remote from our ſight, and from the varieties of other animals that have already become known to us.

For example, ſpurred barley, which is produced by an alteration or decompoſition of the organic ſubſtance of the grain, is compoſed of an infinity of little organized bodies, like to eels. By infuſing the grain for ten or twelve hours in water, we find them to have a remarkable twirling, and a ſlight progreſſive motion; when almoſt dry they ceaſe to move, but by adding freſh water their motion returns. The ſame effects may be produced for months, or even years; inſomuch that we can make theſe little machines act as often and as long as we pleaſe without deſtroying them, or their loſing any of their power or activity. Their threads will ſometimes open, like the filaments of ſemen, and produce moving globules; we may therefore ſuppoſe them to be of the ſame nature, only more fixed and ſolid.

Eels, in paſte made with flour, have no other origin than the union of the organic particles of the moſt eſſential parts of the grain: the firſt which appear are certainly not produced by many others; yet, although they have not been engendered, they engender others. By cutting them with the point of a lancet, we may perceive ſmall eels come from their bodies in great numbers; the body of the animal appears to be only a ſheath or bag which contains a multitude of other little animals, which perhaps are themſelves only ſheaths of the ſame kind, in which the organic matter aſſimilates, and takes the form of eels.

There requires a great number of obſervations to be made to eſtabliſh claſſes and races between ſuch ſingular beings, which are at preſent ſo little known; there are ſome which may be regarded as real Zoophytes which vegetate, and at the ſame time appear to twirl and move like animals. There are ſome that at firſt appear to be animals, which afterwards join and form kinds of vegetables. A little attention to the decompoſition of a grain of wheat infuſed in water will elucidate all I have aſſerted. I could add more examples, but I have related theſe only to point out the varieties there are in generation. There are certainly organized beings which we regard as animals, but which are not engendered by others of the ſame kind; there are ſome which are only a kind of machines, whoſe action is limited to a certain effect, and which can act but once in ſuch a certain time, as thoſe in the calmar; and there are others, as we have juſt remarked, which we can cauſe to act as long and as often as we pleaſe. There are vegetating beings which produce animated bodies, as the filaments of the human ſeed, from whence the active globules ſpring, and which move by their own powers. In the corruption, fermentation, or rather the decompoſition of animal and vegetable ſubſtances, there are organized bodies which are real animals, and can propagate their like, although they have not been ſo produced. The limits of theſe varieties are perhaps ſtill greater than we can imagine. We may extend our ideas, and exert every effort to reduce the effects of Nature to certain points, and claſs her productions to certain claſſes, yet an infinite number of links will always eſcape us.

CHAPTER X.

ON THE FORMATION OF THE FOETUS.

IT appears to be clearly aſcertained by the experiments of Verheyen, who in one of them found the ſeed of a bull in the matrix of a cow; and by thoſe of Ruyſch, Fallopius, Leeuwenhoek, and many others, who perceived the male ſemen in the uterus of women, and numberleſs other animals, that the ſeminal liquor of the male enters by ſome means into the matrix of the female. It is probable, that in the time of copulation the orifice of the matrix opens to receive the ſeminal liquor, but if that is not the caſe, the active and prolific ſubſtance of this liquor, may penetrate the membranes of the matrix; for the ſeminal liquor being, as we have proved, almoſt all compoſed of organic molecules, which are in great motion, and extremely minute, they may paſs acroſs the coat of the cloſeſt membranes, and penetrate thoſe of the matrix with the greateſt facility.

What proves that the active part of this liquor may not only paſs through the pores of the matrix, but even penetrate its ſubſtance, is the ſudden change that immediately takes place after conception. The menſes are ſuppreſſed, the matrix becomes ſofter, ſwells, and appears inflamed. All theſe alterations can only happen by the action of an external cauſe; by the penetration of ſome part of the ſeminal liquor into the ſubſtance even of the matrix. This penetration not only operates on the external ſurface of the matrix, but on all the other parts of which this viſcera is compoſed, like that penetration by which nutrition and expanſion is produced.

We ſhall be eaſily perſuaded that it is ſo, when we conſider that the matrix, during the time of geſtation, not only augments in bulk but alſo in quantity of matter, and that it has

a kind

a kind of life or vegetation, which is continually increaſing till the time of delivery; for if the matrix was only a pouch, a deſtined receptacle to receive the ſeed and contain the fœtus, it would extend and grow thin in proportion as the fœtus increaſed in ſize; but in reality the matrix not only extends in proportion as the fœtus grows larger, but receives at the ſame time a thickneſs and ſolidity. This augmentation is a real growth, like the expanſion of the body in young animals, which can only be produced by the intimate penetration of the organic molecules analogous to the ſubſtance of the parts: and as this expanſion of the matrix never happens but after impregnation, we cannot doubt its being produced by the liquor of the male, eſpecially as the expanſion takes place before the fœtus has ſufficient bulk to dilate it.

It ſeems certain, by my experiments, that the female has a ſeminal liquor which commences to be formed in the teſticles, and is completed in the glandular bodies: this liquor diſtills through the ſmall holes, at the extremities of theſe bodies; and may, like that of the male, enter into the matrix in two different manners, either by theſe holes at the extremities, or through the membraneous coat of the matrix.

Theſe ſeminal liquors are both extracts from all parts of the body, and in the mixture of them there is every thing neceſſary to form a certain number of males and females; and the more the animal abounds with this liquor, and the more that abounds with organic molecules, the greater is their number of young; as we have already remarked is the caſe with the ſmall animals, and diminiſhes in the large.

But to purſue our ſubject with greater attention, we ſhall firſt examine the particular formation of the human fœtus, and afterwards return to the other animals. In the human ſpecies, as well as in large animals, the ſeminal liquors of the male and female do not contain a great abundance of organic molecules, and therefore ſeldom produce more than one at a time: the fœtus is a male, if the number of the organic molecules of the male predominates in the mixture, and a female if the contrary; and it reſembles the father or the mother as they happen to abound in the mixture of the two liquors.

I conceive, therefore, that the ſeminal liquor of both are two matters equally active and neceſſary for generation; and this I think is ſufficiently proved by my experiments, ſince I have ſeen the ſame moving bodies in the one as the other. I perceived that the liquor of the male enters into the matrix, where it meets with that of the female: that they have a perfect analogy, and are both not only compoſed of ſimilar parts by their form, but alſo in their motions and actions; as we have remarked in CHAP. VI.

By the mixture of theſe two liquors I conceive the activity of the organic molecules of each is ſtopped, and that the actions of one counterbalance that of the other, inſomuch that each particle ceaſing to move, remains in the place moſt analogous to itſelf, and that they will naturally take the ſame poſition, and will diſpoſe themſelves in the ſame order they held in the animal body; thoſe that came from the head will arrange themſelves in the head of the fœtus, thoſe of the back the ſame, and ſo of every other part; conſequently they will form a ſmall organized being, in every thing like the animal from which they are extracted.

It muſt be obſerved that this mixture of organic molecules of the two ſexes contains ſimilar and different particles; the ſimilar ones are thoſe which have been extracted from every part common to both ſexes. The different particles are thoſe which have been extracted from the parts whereby the ſexes are diſtinguiſhed; thus there is, in this mixture, double the number of organic molecules to form the head, or the heart, or ſuch other parts common to both, whereas there are only what are requiſite to form the parts of the ſex. Now the ſimilar particles may act upon each other without being diſordered, and collect together as if they had been extracted from the ſame body; but the diſſimilar parts cannot act on each other, nor unite together, becauſe they have not any relation; hence theſe particles will preſerve their nature without mixture, and will fix of themſelves the firſt, without the need of being penetrated by the others. Thus the molecules proceeding from the ſexual parts will be the firſt fixed, and all the reſt which are common to both, will afterwards fix indiſcriminately, whether they are thoſe of the male or female, and form an organized being which, in its ſexual parts, will perfectly reſemble its father, if it is a male, and its mother if a female; but which may reſemble one another, or both, in all the other parts of the body.

It ſeems to me that if this was well underſtood, we ſhall in a great meaſure be enabled to anſwer the objections made to the ſentiments of Ariſtotle, and which might alſo be advanced againſt this ſyſtem. This queſtion is, Why each individual, male and female, does not produce of itſelf an animal of its own ſex? It muſt be acknowledged this queſtion ſeems to carry weight with it; but having reflected a long time on this ſubject I think I have found an anſwer, and which I ſhall endeavour to explain.

It is certainly evident, from what we have ſaid in the preceding chapters, and the experiments we have deſcribed, that reproduction is effected by the union of organic molecules returned from each part of the body of the animal, or vegetable, into one or many common reſervoirs; and that they are the ſame molecules which ſerve for nutriment and expanſion of the body. This rppears to me to have been ſo clearly proved, that I apprehend no ſcruple can remain as to the foundation of the Theory; but I admit there may be ſome reaſon to aſk, Why each animal and vegetable does not produce its own likeneſs, ſince each individual returns from every part of its body, and collects in a common reſervoir all the organic molecules neceſſary for the formation of a ſmall organized being? Why then is not this organized being formed? and, Why in almoſt every animal is a mixture of a liquor of the two ſexes required to produce an animal? If I content myſelf with anſwering, that in almoſt all vegetables, and all kinds of animals which multiply by cutting, that it appears the deſign of Nature that each individual ſhould increaſe its own ſpecies, and that we muſt regard as an exception to this rule, the uſe which is made of the ſexes in the other kind of animals; it may be ſaid, that the exception is more univerſal than the rule itſelf. This difficulty will be very little weakened, if we were to ſay that each individual perhaps would produce its like, if it had proper organs, and contained the neceſſary matter towards the nutriment of the embryo; becauſe females have both this matter and organs, and yet do not produce either male or female fœtus without the intervention of the male; which intervention of ſexes in all animals is eſſential and abſolutely neceſſary.

Although the teſticles and ſeminal veſicles of a man contain all the neceſſary molecules to form a male, yet the local eſtabliſhment and arrangement of theſe molecules cannot be made, becauſe the effect of an union is prevented by the continual circulation of the ſeed both by abſorption, and the action of the new organic molecules which conſtantly come into this reſervoir from all parts of the body. The ſame circumſtances taking place with the organic molecules of the female, is an evident reaſon why neither can produce of themſelves, becauſe when the ſeminal liquors of the male and female are mixed, they have more analogy to each other, than with the parts of the body of the female where the mixture is performed. By admitting of this explication, it may be aſked, Why the common mode of generation in animals does not agree with it; for, upon that ſuppoſition, each individual would produce like ſnails, and impregnate each other, and each individual receiving the organic molecules the other furniſhed, the union would be made of itſelf, and by the ſole power of the affinity of theſe molecules among themſelves? I own, if it was by this cauſe alone the organic molecules could unite it would be natural to conclude, that the ſhorteſt mode to perform the reproduction of animals, would be to give to one individual both ſexes. But it is quite contrary to the general rule purſued by Nature, as this manner of generation is confined to ſnails, and a ſmall number of other animals. This anſwer cannot be ſaid to fully ſatisfy the queſtion, as it merely ſuppoſes the male does not produce, as it cannot receive any thing from the female, and that having beſides no proper viſcera to contain and nouriſh the fœtus.

We may alſo ſuppoſe that the activity of the organic molecules, in the ſemen of one individual, has need of being counterbalanced by the activity or force of thoſe of another individual, in order to fix and bring them into a kind of equilibrium, a ſtate of reſt highly neceſſary to the formation of the animal; and that this activity in the organic molecules can only be counterbalanced by there being a contrary action in thoſe which come from the male, and thoſe proceeding from the female; ſo that, in this ſenſe, all living or vegetating beings muſt have two ſexes, conjointly and ſeparately, to produce their reſemblances. But this anſwer is too general to be entirely clear; nevertheleſs, if we pay attention to all the phenomena, we ſhall find ſome explanation reſulting therefrom. The mixture of theſe two liquors produces not only a male or female fœtus, but alſo other organized bodies, which have a kind of growth or expanſion. The placenta, membranes, &c. are produced at the ſame time as the fœtus. There are, therefore, in the ſeminal liquor of the male or female, or in the mixture of both, not only organic molecules neceſſary for the production of the fœtus, but alſo thoſe which form the placenta and membranes. We know not from whence theſe molecules come, ſince there is no part of the body, either of the male or female, from which they could be ſent back. From hence it ſeems it muſt be admitted, that the molecules of the ſeminal liquors of each being alike active, form organized bodies every time they can fix, by acting mutually one on the other: that the particles employed to form a male will be thoſe of the maſculine ſex, which will fix the firſt, and form the ſexual parts; and that thoſe common to both ſexes will then fix indifferently to form the reſt of the body, and that the placenta and membranes are then formed from the ſuperabundant particles, which have not been uſed to form the fœtus; if, as we ſuppoſe, the fœtus is a male, then there remains to form the placenta and membranes all the organic particles peculiar to the feminine ſex which have not been employed; and alſo all thoſe of both which ſhall not have entered the compoſition of the fœtus, and which cannot be leſs than one half. So likewiſe, if the fœtus is a female, the ſame abundance will be left for the formation of the placenta and membranes, and the whole effects be the ſame, excepting it will have the ſuperfluity of the male, inſtead of that of the female.

But it may be ſaid that in that caſe the placenta and membranes ought to become another fœtus, which would be a female, if the firſt was a male, and a male if the firſt was a female; for the firſt having conſumed the organic molecules of the ſexual parts of only one individual, and half thoſe common to both, there remains all the molecules of the ſexual parts of the other individual, and the other half of thoſe common to both. To this I anſwer, that the firſt union of the organic molecules prevents a ſecond, at leaſt under a ſimilar form; that the fœtus, being the firſt formed, exerciſes an external power, which diſorders the arrangement of the other organic molecules, prevents the formation of a ſecond fœtus, and throws them into a ſtate from which the form of the placenta and membranes reſult.

We are aſſured by the experiments and obſervations we have made, that every living being contains a great quantity of living and active molecules. The life of the animal or vegetable appears to be only the reſult of all the young lives (if that expreſſion is permitted me) of each of theſe active molecules, whoſe life is primitive, and appears impoſſible to be deſtroyed. We have found theſe living molecules in every living or vegetating being, and are aſſured that they are alike neceſſary for nutrition, and conſequently for the reproduction of animals or vegetables. It is not then difficult to conceive, that a certain number of thoſe molecules united ſhould compoſe a living being. Each of theſe particles poſſeſſing animation, an aſſemblage of them muſt be endowed with life, and thus theſe living organic molecules, being common to all living beings, they neceſſarily form any particular animal or vegetable, according as they are arranged. Now this arrangement abſolutely depends on the form of the individuals which furniſh thoſe molecules. If they are furniſhed by an animal, they will arrange under the form of an individual like to it, exactly as they were arranged when they ſerved for the expanſion of the animal itſelf; but muſt we not then ſuppoſe, that this arrangement cannot be made either in animals or vegetables, but by the means of a kind of baſe, round which the molecules might unite to form the fœtus? Now it is plain this baſis is furniſhed by particles peculiar to the different ſexes, as I ſhall explain.

While the molecules of either ſex remain by themſelves, their action produces no effect, becauſe they are without any oppoſition from any different kind of particles; but when theſe molecules are mixed, then there are diſſimilar parts, and thoſe ſerve for the baſe and point of reſt to the other molecules, and fix their activity.

In this ſuppoſition that the organic molecules, which, in the mixture of the ſeminal liquors of the two individuals, repreſent the ſexual parts of the male, can alone ſerve for a baſe to the organic molecules proceeding from every part of the female, and thoſe peculiar to the female ſex as a baſe to them which are extracted from the male, we might conclude, that the ſexual parts of the male infant is formed of the organic molecules of the father, and from thoſe of the mother, for the reſt of the body : and that, on the contrary, the female partakes of her mother only in ſex, and takes the reſt of its body from its father. Boys, therefore, ought, excepting the parts of the ſex, to have a greater reſemblance to their mother than to their father, and girls more to the father than to the mother ; but this conſequence is not, perhaps, conformable to experience.

By conſidering, under this point of view, generation by ſexes, we ſhould conclude it to be the moſt general mode of reproduction, as it is in fact. Beings, whoſe organization is the moſt complete, as animals, whoſe bodies compoſe a whole, which can neither be ſeparated nor divided, and whoſe powers are concentered to one ſingle point, can only reproduce by this mode ; becauſe they contain only particles which reſemble each other, and whoſe union can only be made by different particles, furniſhed by another individual. Thoſe where organization is leſs perfect, as that of vegetables, whoſe bodies may be divided and ſeparated without being deſtroyed, can be reproduced

produced by other modes. Firſt, becauſe they contain diſſimilar particles; ſecondly, becauſe their forms not being ſo determinate and fixed as that of animals, the particles may ſupply the functions of each other, and change according to circumſtances; as we ſee roots become branches, and ſhoot out leaves when expoſed to the air, which cauſes that the vegetable particles obtain a local eſtabliſhment, become fixed, and are enabled to multiply by various modes.

It will be the ſame with animals, whoſe organization is leſs perfect, as the freſh water polypus, and others, which can reproduce by diviſion of their parts. Theſe organized beings are not ſo much a ſingle animal, as a number united under one common covering, as trees are compoſed of a multiplicity of young trees. (ſee Chap. 11.) Pucerons, which engender ſingly, alſo contain diſſimilar particles, ſince after producing their young they change into flies, which do not produce at all. Snails communicate mutually theſe diſſimilar particles, and afterwards they both produce. Thus, in all known matters of generation, we ſee that the requiſite union of organic particles can only be made by the mixture of different particles,

ticles, which ſerve as a baſis capable of fixing their motions.

If to the idea of the word *Sex* we give all the extent here ſuppoſed, we ſhall ſay that ſexes are found throughout all nature; for then ſex will mean only the parts which furniſh the organic particles, different from the common particles, and which muſt ſerve as a fixed point for their union. But, enough of reaſoning on a queſtion that can be at once reſolved, by ſaying, that God having created ſexes, it neceſſarily follows that animals ſhould reproduce by their connection. In fact, we are not made, as I have formerly ſaid, to give a reaſon for every *why*. We are not in a ſtate of explaining *why* Nature almoſt throughout her works makes uſe of ſexes for the reproduction of animals, or why ſexes exiſt; we ought, therefore, to content ourſelves with reaſoning on what is; on things as they are, ſince we cannot go beyond, by forming ſuppoſitions which will remove us from the ſphere we ought to contain ourſelves in, and to which the ſmall extent of our knowledge is limited.

Quitting, therefore, all doubtful conjectures, I ſhall reſt on facts and obſervations. I find that the reproduction of beings is formed in many different manners; but at the ſame time I clearly perceive, that it is by the union of the organic particles ſent back from every part of the individual, that the reproduction of vegetables and animals are effected. I am certain of the exiſtence of theſe organic and active molecules in the ſeminal liquors of male and female animals and ſeed of vegetables; and cannot doubt but every ſpecies of reproduction is accompliſhed by the union of theſe organic molecules. Nor can I doubt, that in the generation of animals, and particularly in that of man, that the male and female particles mix in the formation of the fœtus, ſince we ſee infants which reſemble both father and mother; and what confirms this concluſion is, that thoſe parts common to both ſexes mix promiſcuouſly; whereas thoſe never mix which repreſent the ſexual parts. For we every day ſee children with eyes like the father, and the forehead and mouth like the mother; but we never find a like mixture of the ſexual parts; it never happens that they have the teſticles of the father, and the vagina of the mother, for even the fact of hermaphrodites is very doubtful.

In the parts of generation of the two ſexes in the human ſpecies there is ſo much reſemblance, and ſo ſingular a conformity, that we might be inclined to think thoſe which appear ſo different externally, are at bottom the ſame organs, only more or leſs developed; this was the opinion of the ancients, and M. Daubenton's ideas on the ſubject appeared to me very ingenious.

The formation of the fœtus is, then, made by the union of the organic particles contained in the mixture of the ſeminal liquor of both ſexes; this union produces the local eſtabliſhment of the particles, which determines them to arrange themſelves as they were in the individuals which furniſhed them; inſomuch that the molecules, which proceed from the head, cannot, by virtue of theſe laws, place themſelves in the legs, or any other part of the fœtus. All theſe molecules muſt be in motion when they unite, and in a motion which muſt cauſe them to tend to a kind of centre, about which the union is made. This centre, or fixed point, which is neceſſary to the union of the molecules, and which, by its re-action and inertia, fixes the activity and deſtroys the motion, is probably the firſt aſſemblage of the molecules which proceed from the ſexual parts of the other individual; they muſt arrange under the form of an organized body which will not be another fœtus, for the reaſons we have before given *.

On the whole, I conceive there are organic particles of the ſexual parts, which ſerve as a fixed point, or a centre of union, around which all the other parts that form the embryo collect. I ſpeak of it only as probable; but as they are the only particles which differ, I have thought it more natural to imagine, that it is around theſe different particles the union is formed than thoſe which are common to both ſexes.

We have before obſerved, that thoſe who have imagined the heart was the firſt formed are deceived: thoſe who ſay it is the blood are no leſs ſo; all is formed at the ſame time. If we only conſult obſervation, the chicken is ſeen in the egg before it has been ſat upon; we perceive the ſpine of the back and the head, and at the ſame time the appendages which form the placenta. I have opened a great number of eggs

---

* In this, as in ſome other places, our Author has gone into a diffuſe repetition which we have conſidered unneceſſary and therefore avoid.

eggs before and after incubation; and I am convinced, by my ſight, that the chicken exiſts entirely in the middle of the cicatrice, the moment it comes from the body of the hen. The heat communicated to it by incubation, only expands the parts by ſetting the liquors in motion; but it is not poſſible to determine which parts of the fœtus are fixed in the inſtant of formation.

I have always ſaid that the organic molecules were fixed, and that their uniting was cauſed only by their loſs of motion. This appears to me certain: for if we ſeparately examine the ſeminal liquor of the male and female, we ſhall ſee an infinity of ſmall bodies in great motion, but being mixed, their motion is inſtantly ſuſpended, and heat is neceſſary to renew their activity; for the chicken which exiſts in the centre of the cicatrice is without any motion before incubation; and even twenty-four hours after, when it begins to become perceptible with a microſcope, there is not the leaſt appearance of motion then, nor even the day following. During the firſt day it is only a ſmall white mucilaginous maſs, which is of a conſiſtence on the ſecond, and inſenſibly increaſes, but whoſe motion is very ſlow, and does not at all reſemble that of the organic particles which move rapidly in the ſeminal liquor. Beſides, I have reaſon to ſay, that this motion of the organic molecules is abſolutely deſtroyed; for if we keep an egg without expoſing it to a degree of heat neceſſary to expand the chicken, the embryo, although formed entirely, will remain without any motion; and the organic molecules of which it is compoſed, will remain fixed without being able to give motion and life to the embryo which has been formed by their union. Thus after the motion of the organic molecules has been deſtroyed, after the union of theſe molecules neceſſary to form an animal body, there is ſtill an external agent required to animate and give it life and motion; and this agent is heat, which, by rarefying the liquors, obliges them to circulate and put alſo every organ in action, which afterwards do no more than develope and grow, provided that this external heat continues to aſſiſt them in their functions.

Before the action of this external heat, not the leaſt appearance of blood is to be ſeen; and it is not till twenty-four hours after that I have perceived any change in the colour of the veſſels. The blood firſt appears in the placenta, which communicates with the body of the chicken: but this blood ſeems to loſe its colour as it approaches the body of the animal; for the chicken is entirely white, and we with difficulty diſcover in the firſt, ſecond, and third days after incubation, a few ſmall ſanguinary points which are cloſe to the body of the animal, but which ſeem not to make part of it, although it is theſe ſanguinary points which afterwards form the heart. Thus the formation of the blood is a change occaſioned in the liquors by the motion heat communicates to them, and this blood is formed even out of the body of the animal, the whole ſubſtance of which is then only a kind of mucilage, or thick jelly.

The fœtus, as well as the placenta, derives the neceſſary nutriment for expanſion, by a kind of abſorption, and they aſſimilate the organic parts of the liquor in which they float: for the placenta cannot be ſaid to nouriſh the animal, no more than the animal nouriſhes the placenta; ſince, if the one nouriſhed the other, the firſt would ſoon appear to diminiſh, while the other increaſed, whereas both increaſe together. I have indeed obſerved in eggs, that the placenta at firſt increaſes much more in proportion than the fœtus, and therefore it may nouriſh the animal, or rather convey the nutriment to it, by intus-ſuſception.

What we have juſt ſaid concerning the chicken is eaſily applied to the human fœtus, which is formed by the union of the organic molecules of the two ſexes. The membranes and placenta are formed from the ſuperabundance of the particles which have entered into the compoſition of the embryo: which is then incloſed in a double membrane, where there is alſo a quantity of liquor which is, perhaps, at firſt but a portion of the ſemen of the father and the mother; and as the fœtus does not quit the matrix, it enjoys, from the inſtant even of its formation, an external heat neceſſary for its expanſion; this heat communicates a motion to the liquors, and ſets the organs in play, and blood is formed in the placenta, and in the body of the embryo, by the motion occaſioned by this heat. It may be even ſaid that the formation of the blood of the infant is as independent of the mother, as that which paſſes into the egg is of the hen which hatches it, or of the oven which heats it.

It is certain that the fœtus, placenta, and membranes grow by intus-ſuſception; for, in the earlieſt days of conception, the pouch which contains the whole product of generation, is not adherent to the matrix. De Graaf, in his experiments on doe rabbits, made theſe globules, wherein the whole buſineſs of generation lies, move about in the matrix. Thus in the firſt ſtages they increaſe and grow by drawing nutriment from the liquors which bathe the matrix, to which they are afterwards attached by a mucilage, in which ſmall veſſels are formed with time, as we ſhall hereafter explain.

But, not to quit the ſubject, let us return to the immediate formation of the fœtus, on which there are many remarks to be made both as to its ſituation and the different circumſtances which may prevent or ſtop its formation.

In the human ſpecies, the ſeed of the male enters into the matrix, the cavity of which is conſiderable; and when it meets with a ſufficient quantity of female ſemen, a mixture of the organic particles ſucceed, and the formation of the fœtus enſues: the whole, perhaps, is done inſtantaneouſly, eſpecially if the liquors are both in an active and flouriſhing ſtate. The place where the fœtus is formed is the cavity of the matrix, becauſe the ſeed of the male can enter there more eaſily than into the trunks; and as this viſcera has but one ſmall orifice, which is always ſhut, excepting when the ardour of love cauſes it to open: the materials of generation remain there with ſafety, and ſcarcely ever reiſſue but by rare and unfrequent circumſtances; but as the liquor of the male ſprinkles the vagina, before it penetrates the matrix, by the activity of the organic molecules which compoſe it, it may go farther into the trunks, and perhaps into the ovarium. As the liquor of the female has already its perfection in the glandular bodies of the teſticles, from which it flows and moiſtens the trunks and other parts before it deſcends into the matrix, and as it may iſſue out by the vacuities left around the neck of the matrix, it is not impoſſible that the mixture of the two liquors may be made in all theſe different places. It is therefore probable that fœtuſſes are often formed in the vagina, but which fall out as ſoon as they are formed, becauſe there is nothing to retain them. It may alſo ſometimes happen that fœtuſſes are formed in the trunks; but this caſe is very rare, and cannot happen but when the ſeminal liquor of the male enters the matrix in great plenty.

The collection of anatomical obſervations makes mention of fœtuſſes not only being found in the trunks, but alſo in the teſticles. In the

Hiſtory of the Old Academy of Sciences (vol. II. page 91.) we meet with an obſervation on this ſubject. M. Theroude, a ſurgeon at Paris, ſhewed the academy an unformed maſs, which he found in the right teſticle of a girl of eighteen years of age. In it were two open ſlits furniſhed with hair like two eye-lids; above which was a kind of forehead, with a black line inſtead of eyebrows; immediately over that were many hairs matted together in two ſeparate lines, one of which was ſeven and the other three inches long; under the great angle of the eye two of the grinding teeth appeared to ſhoot, hard, thick, and white; they had their prongs, and a third tooth thicker than the reſt above them. There appeared likewiſe other teeth at different diſtances from each other: two between theſe of the canine nature, iſſued from an opening where the ear is placed. In the ſame volume, page 144, it is related, that M. Mery, found in the teſticle of a woman, who had conceived, a bone of the upper jaw, with many teeth therein, ſo perfect that ſome appeared to be of more than ten years growth. We find, in the *Journal de Medecine*, for January 1683, publiſhed by the Abbé de la Roque, the hiſtory of a lady who died with the ninth child, which was formed in or near one of the teſticles which is not very clearly explained. The fœtus was about an inch an ſize, completely formed, and the ſex eaſily to be diſtinguiſhed. We alſo find, in the Philoſophical Tranſactions, ſome obſervations on the teſticles of women, wherein teeth, hair, and bones have been found. If all theſe circumſtances are true, we muſt ſuppoſe that the ſeminal liquor of the male ſometimes aſcends, although very ſeldom, to the teſticles of the female. Yet notwithſtanding all this, I have ſome difficulty to believe it; firſt, becauſe the circumſtances which appear to prove it are extremely rare; ſecondly, becauſe a perfect fœtus has never been ſeen in the teſticles but by M. Littre, who ſeems to relate it in a very ſuſpicious manner; thirdly, becauſe it is not impoſſible that the ſeminal liquor of the female alone may produce organized maſſes, as moles, hair, bones, fleſh, and, in ſhort, becauſe if we give credit to anatomiſts, fœtuſſes may be formed in the teſticles of men, as well as in thoſe of women: for we find in the Hiſtory of the Royal Academy, VOL. II. p. 298, an obſervation of a ſurgeon, who ſays, he diſcovered in the ſcrotum of a man the figure of a child incloſed in his membranes; and that the head, feet, eyes, bones, and cartilages, were diſtinguiſhable. If all theſe obſervations were equally true, we muſt neceſſarily adopt one of theſe two hypotheſes, either that the ſeminal liquor of each ſex cannot produce any thing without being mixed with that of the other ſex; or that either of them can produce irregular maſſes of itſelf. By keeping to the firſt, we ſhould be obliged to admit, to explain in all the circumſtances we have related, that the liquor of the male ſometimes aſcends to the teſticle, and by mixing with the ſeminal liquor of the female forms organized bodies; and ſo may alſo the female fluid, by being plentiful in the vagina, penetrate during the time of copulation into the ſcrotum of the male, nearly as the venereal virus often reaches that part; and that in this caſe an organized body may be found in the ſcrotum, by the mixture of the male and female fluids; or if we admit the other hypotheſis, which appears to be the moſt probable, and ſuppoſe that the ſeminal liquor of each individual may produce organized maſſes, then we may be able to ſay that all theſe bony, fleſhy, and hairy productions, ſometimes found in the teſticles of females, and in the ſcrotum of males, may derive their origin from the liquor of the individual in which they are found. But enough of obſervations upon facts which appear to be as uncertain as inexplicable, for I am much inclined to believe that, in certain circumſtances, the ſeminal liquor of each individual may produce ſomething alone and of itſelf, and that young girls might form moles without any communication with the male, as hens form eggs without having received the cock. I might ſupport this opinion with obſervations which appear to me as credible as thoſe I have quoted. M. de la Saone, phyſician and anatomiſt of the Academy of Sciences, publiſhed a memoir on this ſubject, in which he aſſerts, that religious nuns, though ſtrictly cloiſtered, had formed moles. Why ſhould that be impoſſible, ſince hens form eggs without communication with the cock? and in the cicatrice of theſe eggs we perceive a mole with appendages inſtead of a chicken? The analogy appears to me to have ſufficient power for us at leaſt to doubt, or ſuſpend our determination. Be this as it will, it is certain that the mixture of the two liquors are required to form a fœtus, and that this mixture cannot come to any effect but when it is in the matrix, where the anatomiſts have ſometimes found fœtuſſes ; and it is natural to imagine, that thoſe which have been found out of the matrix, and in the cavity of the abdomen, have eſcaped by the extremity of the trunks, or by ſome accidental opening, and that they never fall from the teſticles into the abdomen, becauſe it is almoſt an impoſſibility that the ſeminal liquor of the male can aſcend ſo high. Leeuwenhoek has computed the motion of theſe pretended ſpermatic animals to be four or five inches in forty minutes, which would be more than ſufficient for the animalcules to traverſe from the vagina into the matrix, from the matrix into the trunks, and from the trunks into the teſticles, in an hour or two, provided all the liquor had that motion. But how is this to be conceived, that the organic molecules, whoſe motion ceaſes as ſoon as the liquid fails, can arrive as far as the teſticles, unleſs brought there by the liquor in which they ſwim ? This progreſſive motion cannot be given by the organic molecules to the liquor which it contains, therefore whatever activity theſe molecules may be ſuppoſed to have, we cannot ſee how they can arrive at the teſticles and form a fœtus there, unleſs the liquor itſelf was pumped up and attracted thither, a ſuppoſition not only gratuitous but even againſt all human probability.

The doubts which this ſuppoſition gives riſe to, confirm the opinion that the male fluid penetrates the matrix, and enters therein by the orifice, or acroſs the membraneous coat of the viſcera. The female fluid may alſo enter into the matrix, either by the opening at the upper extremity of the trunks, or acroſs the ſkin even of the trunks and matrix. M. de Weirbrech, an able anatomiſt of Peterſburgh, confirms this opinion:——" Res omni attentione digniſſima (ſays he) oblata mihi eſt in utero feminæ alicujus a me diſſectæ; erat uterus ea magnitudine qua eſſe ſolet in virginibus, tubequæ ambæ apertæ quidem ad ingreſſum uteri, ita ut ex hoc in illas cum ſpecillo facile poſſem tranſire ac flatum injicere, ſed in turbarum extremo nulla debatur apertura, nullus aditus; ſimbriarum enim ne veſtigium quidem aderat, ſed loco illarum bulbus aliquis pyriformis materia ſubalbida fluida turgens, in cujus medio fibra plana nervea, cicatriculæ æmula, apparebat, quæ ſub ligamentuli, ſpecie uſque ad ovarii involucra protendebatur.

"Dices, eadem a Regnero de Graaf jam olim notata. Equidem non negaverim illuſtrem hunc proſectorem in libro ſuo de organis mulieribus non modo ſimilem tubam delineaſſe, Tabula XIX, fig. 3, ſed & monuiſſe, 'tubas quamvis ſecundum ordinariam naturæ diſpoſitionem in extremitate ſua notabilem ſemper coarctationem habeant, prætur naturam tamen aliquando claudi;' verum enimvero cum non meminerit auctor an id in utraque tuba ita deprehenderit; an in virgine; an ſtatus iſte præternaturalis ſterilitatem inducat; an vero conceptio nihilominous fieri poſſit; an a principio vitæ talis ſtructura ſuam originem ducat; ſive an tractu tempora ita degenerare tubæ poſſint; facile perſpicimus multa nobis relicta eſſe problemata quæ, utcumque ſoluta, multum negotii faſcecant in exemplo noſtro. Erat enim hæc ſemina maritata, viginti quatuor annos nata, quæ filium pepererat quem vidi ipſe, octo jam annos natum. Dic igitur tubas ab incunabulis clauſas ſterilitatem inducere: quare hæc noſtra femina peperit! Dic concepiſſe tubis clauſis; quomodo ovulum ingredi tubam potuit! Dic coaluiſſe tubas poſt partum: quomodo id noſti! Quomodo adeo evaneſcere in utroque latere fimbriæ poſſunt,

tanquam nunquam adfuiſſent! Si quidem ex ovario ad tubas alia daretur via, præter illarum orificium, unico greſſu omnes ſuperarentur difficultates; ſed fictiones intellectum quidem adjuvant, rei veritatem non demonſtrant; præſtat igitur ignorationem fateri, quam ſpeculationibus indulgere*." The difficulties which occurred to this able author are inſurmountable in the egg ſyſtem, but which diſappear in our explanation. This obſervation ſeems only to prove what we have obſerved, that the ſeminal liquor of both male and female may penetrate the coat of the matrix, and enter acroſs the pores of the membranes; to be aſſured of it, it is only neceſſary to pay attention to the alteration that the ſeminal liquor of the male cauſes to the viſcera, and to the kind of vegetation or expanſion that it cauſes there. Beſides, the liquor which iſſues by the vacuities of De Graaf, being of the ſame nature as the liquor of the glandular bodies, it is very evident that this liquor comes from the teſticles, and yet there is no veſſel through which it can paſs; conſequently we muſt conclude, that it penetrates the ſpongy coat of all theſe parts, and

---

* Vide Comment. Acad. Petropol. vol. IV. page 261 and 262.

and that it not only enters the matrix, but even can iſſue out when theſe parts are in irritation.

But even ſhould we refuſe this idea of penetration, we cannot deny that the liquor of the female, which flows from the glandular bodies of the teſticles, may enter by the opening at the extremity of the trunk, as that of the male does by the orifice of the viſcera; and that conſequently theſe two liquors may mix of themſelves in this cavity, and form there the fœtus in the manner we have explained.

CHAPTER XI.

OF THE EXPANSION, GROWTH, AND DELIVERY OF THE FOETUS, &c.

IN the expanſion of the fœtus, two different degrees of growth make different kinds of expanſion. The firſt, which ſucceeds immediately after the formation of the fœtus, is not proportionable in all the parts of which it is compoſed. The more diſtant it is from the formation, the more in proportion are its parts, and it is only after it has quitted the womb of its mother that the growth of the parts is made in nearly an equal manner. It muſt not be imagined that the figure of the fœtus, at the moment of formation, is abſolutely like that of an adult. It is certain that the embryo contains every part which muſt compoſe a man, but they differ in their ſucceſſive expanſion.

In an organized body, as that of an animal, we may ſuppoſe ſome parts are more eſſential than others, and though ſome may be uſeleſs or ſuperfluous, there are ſome on which the reſt ſeem to depend for their expanſion and diſpoſition. We muſt conſider ſome as fundamental parts, without which the animal cannot exiſt, and which are more acceſſory and external, and appear to derive their origin from the firſt, and which ſeem to be formed as much for the ornament, ſymmetry, and external perfection of the animal, as for the neceſſity of its exiſtence, and the exerciſe of the eſſential functions of life. Theſe two kinds of different parts expand ſucceſſively, and are almoſt equally apparent when the fœtus quits the womb; but there are others which Nature ſeems to keep in reſerve, as the teeth, which do not appear for ſome time, and alſo the glandular bodies in the teſticles of females, the beards of males, &c. which do not ſhew themſelves till the age of puberty.

In order to diſcover the fundamental and eſſential parts of an animal body, we muſt pay attention to the number, ſituation, and nature of the whole; thoſe which are ſimple, thoſe whoſe poſition is invariable, and thoſe without which the animal cannot exiſt, will be the eſſential parts; thoſe, on the contrary, which are double, or in a greater number, thoſe whoſe ſize and poſition vary, and thoſe which may be retrenched from the animal without deſtroying or even doing it an injury, may be looked upon as leſs neceſſary, and more acceſſary, to the animal machine. Ariſtotle has ſaid that the only parts eſſential to animals were thoſe with which they take their nutriment, and throw out the ſuperfluous parts of it from the body. From the mouth to the arms are ſimple parts, which no other can ſupply. The head and ſpine of the back are alſo ſimple parts, whoſe poſition is invariable. The ſpine of the back ſerves for a foundation to the fabric of the body; and it is from the marrow which it contains that the motion and action of moſt of the members and organs proceed; it is alſo this part which appears one of the firſt in the embryo. Now theſe ſimple parts which appear the firſt are all eſſential to the exiſtence and form of the animal. There are many more double than ſimple parts in the body of an animal, and ſeem to be produced on each ſide of the ſimple parts by a kind of vegetation; for theſe double parts are ſimilar in form, and different in poſition. The left hand exactly reſembles the right, becauſe it is compoſed of the ſame number of parts; nevertheleſs, if it was placed in the ſituation of the right, we could not make uſe of it for the ſame purpoſes, and ſhould have reaſon to regard it as a very different member. It is the ſame with reſpect to the other double parts; they are ſimilar as to form, and different as to the poſition which is connected to the body of the animal; and by ſuppoſing a line to divide the body into two equal parts, the poſition of all the ſimilar parts would refer to this line as a centre.

The ſpinal marrow, and the vertebræ which contains it, appear to be the real axis, to which we muſt refer all the double parts of the animal, for they ſeem to derive their origin, and to be only ſymmetrical branches iſſuing from this trunk or common baſe, for we ſee the ribs ſhoot out on each ſide of the vertebræ in the young chicken as the young branches ſhoot out from the principal branch of a tree. In all embryos the middle of the head and vertebræ appear to be the firſt formed; afterwards we ſee on the two ſides of a veſicle which forms the middle of the head two other veſicles which appear to proceed from the firſt. Theſe two veſicles contain the eyes and the other double parts of the head; ſo likewiſe we perceive little tubercles ſhoot out in equal numbers from each ſide of the vertebræ, which extend by degrees and form the ribs, and other double parts of the trunk. On the ſide of this trunk already formed, as the concluſion, the legs and arms appear. This firſt expanſion is very different from that which is made afterwards; it is the production of parts which appear for the firſt time; that which ſucceeds is only a growth of all the parts already created.

This ſymmetrical order of all the double parts found in every animal, the regularity of their poſition, the equality of their extenſion and growth, and the perfect reſemblance between them, ſeem to indicate that they derive their origin from the ſimple parts; that there muſt reſide in theſe ſimple parts a power which acts equally on each ſide, or, which anſwers the ſame meaning, they are the fixed points againſt which the power that produces the expanſion of the double parts is exerciſed. That the power which acts on the right is equalled by that of the left ſide, and conſequently they are counterbalanced by this re-action.

From hence we may infer, that if there is any defect or exceſs in the matter which is to ſerve for the formation of the double parts, as the powers which impel them on each ſide are equal, the defect or exceſs muſt be formed the ſame both on the right and left; for example, if, from a defect of matter, a man has but two fingers inſtead of five on the right hand, he will have but two on the left hand; or if, by an exceſs of matter, he has ſix fingers on one hand, he will have ſix on the other; or if the matter be vitiated, and cauſes an alteration in the right part, it will be the ſame on the left. This fact is very often ſeen. Moſt monſters are made with ſymmetry; the diſarrangement of the parts of monſters appears to be made with order; Nature, therefore, even in her errors, miſtakes as little as poſſible.

This harmony of poſition in the double parts of animals is found alſo in vegetables; branches ſhoot out from buds on every ſide; the veins in the leaves are equally diſpoſed as to the principal vein; and although ſymmetrical order appears to be leſs exact in vegetables than in animals, it is only becauſe it is more varied, and its limits are more extended, and leſs preciſe; but we may nevertheleſs eaſily diſcover this order, and diſtinguiſh the ſimple and eſſential parts from thoſe which are double, and the latter we muſt regard as having taken their origin from the former. We ſhall more fully diſcuſs this point, as far as relates to vegetables, when we come to treat of them.

It is not poſſible to determine under what form the double parts exiſt before expanſion, nor in what manner they are folded, nor what figure reſults from their poſition by connection with the ſimple parts. The body of the animal, in the inſtant of formation, certainly contains every part which is to compoſe it; but the relative poſition of theſe parts muſt be very different then from what it becomes afterwards. It is the ſame with vegetables, for if we obſerve the expanſion of a young leaf, we ſhall perceive that it is folded on both ſides the principal vein, and that its figure does not reſemble at that time what it afterwards aſſumes.

When we amuſe ourſelves by folding paper to form crowns, boats, &c. the different folds of the paper ſeem to have no reſemblance to the form which muſt reſult by the unfolding; we only ſee that theſe folds are always made in an uniform order, and exactly the ſame on one ſide as that we have made on the other; but it would be a problem beyond known geometry, to determine the figures which may reſult from all the unfoldings of a certain given number of folds. All what immediately relates to the poſition is beyond our mathematical ſciences. This art, which Leibnitz calls *Analyſis Situs*, is not yet found out; though this art, which would ſhew us the connections that reſult from the poſition of things, would perhaps be more uſeful than that which has only bulk for its object, for we have often more need to know the form than the matter.

In the unfolding of Nature's productions, not only the folded parts take new poſitions, but they acquire, at the ſame time, extent and ſolidity. Since we cannot therefore determine the reſult of the ſimple unfolding of a folded form, in which, as in a piece of folded paper, there is but one change of poſition between the parts, without any augmentation or diminution of the bulk or maſs of the matter, how is it poſſible for us to judge of the complex unfolding of the body of an animal, in which not only the relative poſition of the parts, but alſo their maſs of matter, undergoes conſiderable changes? We cannot, therefore, reaſon upon this ſubject, but by drawing ſome inductions from the examination of things at the different periods of their unfolding, and by aſſiſting ourſelves with the obſervations that we have had the opportunities to make.

It is true we ſee the chick in the egg before incubation; it floats in a tranſparent liquor, contained in a ſmall purſe, formed by a very fine membrane in the centre of the cicatrice; but this chick is then only a particle of inanimate matter, in which we cannot diſcern any organization, nor any determined figure. We judge by the external form that one of the extremities is the head, and the reſt to be the ſpine of the back. It appears that this is the firſt product of fecundation reſulting from the mixture of the ſeed of the male and female;

nevertheleſs, before aſſerting this as a fact, there are many things ſhould be conſidered. When the hen has cohabited with the cock for a few days, and afterwards ſeparated from him, the eggs ſhe produces for a month after ſeparation are as fertile as thoſe ſhe produced during the time of cohabitation with the male, and unfold at the ſame time: they only require twenty-one days ſitting, and the embryo of the one will be as forward and as completely formed as that of the other. From hence we might think, that this form, under which the chick at firſt appears to us in the egg, does not immediately proceed from a mixture of the two liquors, but that it exiſted in other forms during the time the egg remained in the body of the mother; for the embryo, in the form we ſee it before incubation, requires only heat to unfold and bring it forth. Now, if it had this form twenty days, or a month before, when the egg was firſt fecundated, why was it not hatched by the internal heat of the hen? and why is not the chicken perfectly formed in thoſe eggs which are fecundated twenty-one days before the hen lays them?

This difficulty is not ſo great as it appears; for we muſt conceive, that in the time of the cock's cohabitation with the hen, each egg receives in its cicatrice, wherein the female liquor is contained, a ſmall portion of the ſemen of the male. The egg attached to the ovary is in oviparous females, what the glandular ſubſtance is in the teſticles of viviparous females. The cicatrice of the egg correſponds with the glandular bodies in which the ſeminal liquor of the female reſides; that of the male penetrates and mixes there with it; from this mixture, the formation of the embryo inſtantly reſults. The firſt egg which the hen lays after coition is fecundated, and capable of producing a chicken; thoſe which ſhe lays afterwards were fecundated at the ſame inſtant; but as there is ſtill wanting eſſential parts to this egg, the production of which is independent of the ſeed of the male, as the white, membranes, and ſhell, the young embryo contained in the cicatrice cannot unfold in this imperfect egg, although aſſiſted by the internal heat of the mother. It remains, therefore, in the cicatrice in the ſtate in which it was formed, until the egg has acquired all the parts neceſſary to the growth and nouriſhment of the chicken: and it is not till the egg has attained its perfection that the embryo begins to unfold:

this unfolding is performed by the external heat of incubation; but it is certain, if the egg could be confined within the body of the hen for 21 days after it was completely formed, the chicken would be produced, unleſs the internal heat of the hen ſhould prove too powerful, for the degrees of heat neceſſary to hatch chickens are not very extended, and the leaſt defect or exceſs is equally prejudicial to their unfolding. The laſt eggs the hen lays, containing the ſame as the firſt, proves nothing more than that the egg muſt acquire entire perfection before the embryo can unfold itſelf; and for want of the heat neceſſary to this unfolding, eggs may be kept a conſiderable time before incubation, without preventing the produce of the chickens they contain.

It appears, therefore, that the ſtate of the embryo, when the egg is laid by the hen, is the firſt ſtate which ſucceeds fecundation; that the form under which we ſee it is the firſt form reſulting from the intimate mixture, and from the penetration of the two ſeminal liquors; and conſequently by following, as Malpighius has done, this unfolding from hour to hour, we diſcover all that is poſſible to be known, unleſs we could ſee the two liquors mix before our eyes, and how the firſt arrangement of the particles are made, which produces the firſt form of the embryo.

If we reflect on this fecundation (which is made at the ſame time) of theſe eggs, which are laid ſucceſſively, and a long time after each other, we ſhall find new arguments againſt the exiſtence of eggs in viviparous animals; for if the females of viviparous animals, or if women contained eggs, like hens, why are there not many fecund at the ſame time? why are not ſome of them produced in nine months, and others at diſtant periods? and when women have two or three children, why do they all come into the world at one time? If theſe fœtuſſes were produced by the means of eggs, would not they come ſucceſſively, according as the eggs came to perfection, after the time of impregnation? And would not ſuper-fœtation be as frequent as they now are ſcarce, or as natural as they appear to be accidental?

We cannot follow the unfolding of the fœtus in the matrix as we purſue that of the chick in the egg; the opportunities of obſerving it are few, and we can only know what anatomiſts, ſurgeons, and midwives have written thereon. It is by collecting all their particular obſervations, and by comparing their remarks and their deſcriptions, that we have made the following abridged hiſtory of the human fœtus.

There is a great appearance that, immediately after the mixture of the two ſeminal liquors, the whole materials of generation exiſt in the matrix under the form of a globe; ſince we know, by anatomiſts, that three or four days after conception there is a ſmall oval ball in the matrix, this ball is formed by an extremely fine membrane, which incloſes a limpid liquor like the white of an egg. We can then perceive ſome ſmall united fibres in this liquor, which are the firſt outlines of the fœtus. A net-work of fine fibres collects on the ſurface of the ball, which extends from one of the extremities to the middle. Theſe are the firſt veſtiges of the placenta.

Seven days after conception we may diſtinguiſh, by the naked eye, the firſt lineaments of the fœtus, as yet unformed; being only a maſs of tranſparent jelly, which has acquired ſome ſmall degree of ſolidity; the head and trunk are eaſily diſcernible, becauſe this maſs is of an oblong form, and the trunk is more delicate and ſomewhat longer. Some ſmall fibres, in form of a plume of feathers, ſpring from the body of the fœtus, and which turn towards the membrane in which it is included; theſe fibres are to form the umbilical cord.

Fifteen days after conception the head, and the moſt apparent features of the face, are diſtinguiſhable; the noſe reſembles a ſmall prominent and perpendicular thread affixed to a line, which indicates the diviſion of the lips. Two ſmall black points are in the places of the eyes, and two little holes in thoſe of the ears; the body of the fœtus has alſo received ſome growth. On each ſide of the upper and inferior parts of the trunk, little protuberances appear, which are the firſt outlines of the arms and legs.

Eight days after, that is in three weeks, the body of the fœtus has only increaſed about a line; but the arms and legs, the hands and feet, are apparent; the growth of the arms is more quick than that of the legs, and the fingers ſeparate ſooner than the toes. At this time internal organization begins to be diſcernible; the bones appear like ſmall threads as fine as hairs; the ribs are diſpoſed regularly from the two ſides of the back-bone; and as well as the arms, legs, fingers, and toes, are repreſented by very ſmall threads.

At a month the fœtus is more than an inch long; it naturally takes a curved poſture, in the middle of the liquor which ſurrounds it, and the membranes which contain the whole are increaſed in extent and thickneſs; the maſs is oval, and it is then about an inch and an half in its greateſt, and an inch and a quarter the ſmalleſt diameter. The human figure is no longer equivocal, every part of the face is already diſcernible; the body is faſhioned, the thighs and belly are ſeen, the limbs formed, the toes and fingers divided, the ſkin thin and tranſparent, the viſcera marked by fibres, the veſſels as fine as threads, and the membranes extremely delicate, the bones are as yet ſoft, and have only taken ſolidity in ſome few parts; the veſſels which compoſe the umbilical cord, are as yet in a ſtraight line by the ſide of each other; now the placenta only occupies a third of the whole maſs; whereas in the beginning it occupied the half. It appears, therefore, that its growth, in ſuperficial extent, has not been ſo great as that of the fœtus, and the reſt of the maſs; but it has increaſed much more in ſolidity; its thickneſs has become greater in proportion than the membranes of the fœtus, both of which are now eaſily diſtinguiſhed.

According to Hippocrates, the male fœtus is developed ſooner than the female. He ſays, all parts of the body in the firſt are apparent in thirty, whereas the latter are not ſo till the expiration of forty-two days.

In ſix weeks the fœtus is nearly two inches long; the human figure begins to be more perfect; the head is only larger in proportion than the other parts of the body; the motion of the heart is perceived about this time. It has been ſeen to beat in a fœtus of ſixty days, a long while after it had been taken out of the womb of its mother.

In two months the fœtus is more than two inches long; the oſſification is diſcernible as far as the middle of the arm, thigh, and leg, and in the point of the lower jaw, which is then very forward before the upper. Theſe, however, are only oſſified points; but by the effect of a more ready expanſion, the clavicles are wholly oſſified. The umbilical cord is formed, and the veſſels which compoſe it, begin to twiſt nearly like threads which compoſe a rope: but this cord is ſtill very ſhort in compariſon of what it becomes hereafter.

In three months the fœtus is nearly three inches long, and weighs about three ounces. Hippocrates ſays, that it is at this time the motion of the male fœtus begins to be felt by its mother; but that thoſe of the female are not felt till after the fourth: there are women who affirm they have felt the motions of the child at the beginning of the ſecond month. It is very difficult to be certain on this ſubject, the ſenſations excited by the firſt motions of the fœtus depending, perhaps more on the ſenſibility of the mother than the ſtrength of the child.

Four months after conception the length of the fœtus is ſix or ſeven inches; every part of its body is ſo greatly augmented as to be perfectly diſtinguiſhed from each other; even the nails appear on the fingers and toes. The teſticles of the males are ſhut up in the belly above the kidnies; the ſtomach is filled with ſomewhat of a thick humour, like that which incloſes the amnios. We find a milky fluid in the little veſſels, and in the large ones a black liquid matter. There is a little bile in the gall, and ſome urine in the bladder. As the fœtus floats freely in the liquid which ſurrounds it, there is always a ſpace between the body and membranes in which it is contained.

Theſe coverings grow at firſt more than the fœtus; but after a certain time it is quite the contrary. Before the end of the third month the head is bent forward, the chin reſts on the breaſt, the knees are lifted up, the legs bent backwards upon the thighs (ſometimes the knees are ſo high as almoſt to touch the jaws), the arms are generally folded acroſs the breaſt, and one of the hands, and often both, touch the face. The fœtus afterwards takes different ſituations, as it acquires ſtrength. Experienced midwives have pretended to be certain that it changes much oftener than is commonly thought, and which they prove by ſeveral obſervations; firſt, the umbilical cord is often found twiſted round the body and limbs of the child, in a manner which neceſſarily ſuppoſes, that the fœtus has moved in many directions, and taken different poſitions; ſecondly, a mother feels the motions of the fœtus ſometimes on one ſide of the womb and ſometimes on another; and it often ſtrikes againſt many different places, which muſt be occaſioned by different poſitions, and ſuppoſes that it takes different ſituations; thirdly, as it floats in a liquid which ſurrounds it on all ſides, it can very eaſily turn and extend itſelf by its own ſtrength; and it muſt alſo take different ſituations according to the various attitudes of the mother; for example, when ſhe lies down, the fœtus muſt be in another ſituation to what it was when ſhe ſtood upright.

Moſt anatomiſts have ſaid, that the fœtus is conſtrained to bend its body, becauſe it is too confined in its covering; but this opinion does not appear well founded, for in the firſt five or ſix months there is more ſpace than is required for the fœtus to extend, and yet during that time it is bent and folded. We alſo ſee the chicken is in a curved poſture in the liquor of the amnios, although this membrane and its liquor are ſufficient to contain a body five or ſix times as large as the fœtus. Thus we may conclude that this curved form of the fœtus is natural, and not the effect of force. I am ſomewhat of Harvey's opinion, who ſays, it takes this attitude becauſe it is the moſt favourable to reſt and ſleep; and as the fœtus ſleeps almoſt continually, it naturally takes the moſt advantageous ſituation. "Certe (ſays this famous anatomiſt) animalia omnia, dum quieſcunt & dormiunt, membra ſua ut plurimum adducunt & complicant, figuramque ovalem ac cònglobatam quærunt: ita pariter embryones qui ætatem ſuam maxime ſomno tranſigunt, membra ſua poſitione ea qua plaſmantur (tanquam naturaliſſima ac maxime indolenti quietique aptiſſima) componunt *."

The matrix, as we have already ſaid, takes a very ready growth after conception, and it continues alſo to increaſe in proportion with the fœtus; but the fœtus at length outgrows the matrix, and then, eſpecially when it approaches maturity, it may be too much confined, and agitate the matrix by reiterated motions and violent efforts. The mother ſenſibly feels the impreſſion of theſe painful ſenſations, and which are called periodic pains after the labour commences. The more power the fœtus exerts to dilate the matrix the greater it finds the reſiſtance, from the natural compreſſion of the parts. From thence all the effect falls on the orifice, which has been increaſing by degrees during the latter months of pregnancy. The head of the fœtus, forcibly inclining againſt the ſides of the orifice, dilates it, by a continual preſſure, till the moment of delivery, when it opens ſufficiently for the child to eſcape from the womb.

What makes it probable that the labour-pains proceed only from the dilatation of the orifice

---

[*] Harvey on Generation, page 257.

orifice of the matrix is, that this dilatation is the only means to diſcover whether the pains felt are in fact the pains of labour, for women often feel very ſenſible pains, which are not thoſe that immediately precede delivery. To diſtinguiſh the falſe from true pains, it has been recommended for the midwife to touch the orifice of the matrix, as if the pains be true the dilatation will always increaſe, and if they are falſe pains, that is to ſay, pains which proceed from ſome other cauſe than that of the approaching delivery, the orifice will contract rather than dilate, or at leaſt will not continue to dilate. From hence we have ſufficient foundation to imagine, that theſe pains proceed from a forced dilatation of the orifice. The only thing which embarraſſes on this occaſion is that alternative of reſt and ſufferings the mother endures. This circumſtance of the effect does not perfectly agree with the cauſe which we have juſt indicated; for the dilatation of an orifice, which is made by degrees, ſhould produce a conſtant and continued pain, without any intervals of eaſe. But poſſibly the whole may be attributed to the ſeparation of the placenta, which we know is faſtened to the matrix by a number of papillæ, which penetrate into the vacuities or cavities of this viſcera; therefore may it not be ſuppoſed that they do not ſeparate from their cavities all at the ſame time; that each ſeparation cauſes thoſe acute pains, and the intervals between are thoſe of eaſe and reſt? The effect in this caſe perfectly anſwers the cauſe, and we can ſupport this conjecture by another obſervation.—Immediately before delivery there iſſues a whitiſh and viſcous liquor, like that which flows from the nipples of the placenta when drawn out of their places, which makes it probable that this liquor, which then iſſues from the matrix, is produced by the ſeparation of ſome of the papillæ of the placenta.

It often happens that the fœtus quits the matrix without burſting the membranes, and conſequently without the contained liquor flowing out. This kind of delivery appears to be moſt natural, and reſembles that of moſt animals; nevertheleſs, the human fœtus commonly pierces its membranes by the reſiſtance it meets with at the orifice of the matrix. It alſo ſometimes brings away part of the amnios, and even the chorion, upon its head like a cap. When theſe membranes are pierced or torn, the liquors, called the *waters*, which they contain flow out, and the ſides of the orifice of the matrix, and the vagina, being thus moiſtened, give way more eaſily to the paſſage of the child. After the flowing of this liquor there remains ſufficient room in the matrix for the midwife to return the child, if the poſition is unfavourable. When the fœtus is come out the delivery is not entirely completed, the placenta and membranes remain in the matrix, and the new-born infant adheres to them by the umbilical cord; the hand of the midwife, or the weight of the body of the infant alone, draws them out by means of this cord. Thoſe organs which were neceſſary to the life of the fœtus become uſeleſs, and even noxious to the new-born infant. They are inſtantly ſeparated from the body of the child, by tying the umbilical cord about an inch diſtance from the navel, and by cutting it about an inch from the ligature. The remainder of this cord dries away, and ſeparates of itſelf from the navel, about the ſixth or ſeventh day.

On examining the fœtus previous to its birth we may form ſome idea of its natural functions. It has organs, which are neceſſary to it while in the womb of its mother, but which become uſeleſs. For the better underſtanding the mechaniſm of theſe functions, we muſt explain a little more particularly the nature of thoſe neceſſary parts, the umbilical cord, the membranes, the liquor which they contain, and the placenta. The umbilical cord, which is attached to the body of the fœtus at the navel, is compoſed of two arteries and one vein; theſe prolong the circulation of the blood, but the vein is larger than the arteries. At the extremity of the cord each of theſe veſſels divide into an infinity of ramifications, which extend between two membranes. They ſeparate at equal diſtances from the common trunk; ſo that theſe ramifications are round and flat, and are called, when thus collected, the *placenta*. The external ſurface, which is applied againſt the matrix, is convex; the internal concave. The blood of the fœtus circulates in the cord, and in the placenta. The arteries of the cord ſpring from two large arteries of the fœtus, and carry the blood through the arterial ramifications of the placenta; from thence it paſſes into the venous branches which carries it into the umbilical veſſels; theſe communicate with a vein of the fœtus, in which veſſels it is received.

The concave ſurface of the placenta is cloathed by the chorion; the convex is alſo covered by a kind of ſoft membrane, eaſily torn, which ſeems to be a continuation of the chorion, and the fœtus is included under the double coat of the chorion and the amnios. The form is globular, becauſe the intervals between the membranes and the fœtus are filled with a tranſparent liquor. This liquor is contained by the amnios, which is the internal membrane, it is thin and tranſparent; it folds round the umbilical cord at its inſertion into the placenta, and covers it the whole length to the navel of the fœtus. The chorion is the external membrane; it is thick and ſpongy, ſprinkled with ſanguinary veſſels, and compoſed of many coats, the exterior of which covers the convex ſurface of the placenta. It follows the inequalities, and covers the papillæ, which ſpring from the placenta, and are received in the cavities found at the bottom of the matrix, called *lacunæ*. The fœtus adheres to the matrix by theſe inſertions.

Some anatomiſts have thought that the human form had, like thoſe of certain quadrupeds, a membrane called *allantois*, deſtined to receive the urine; and they have pretended to have found it between the chorion and the amnios, or in the middle of the placenta at the root of the umbilical cord, under the form of a very large bladder, in which the urine entered by a long pipe that compoſed part of the cord, and which opened on one ſide into the bladder, and on the other in this allantois membrane, being ſimilar to the urachus in other animals. They owned, however, that it was not near ſo large in the human fœtus as in quadrupeds, but that it was divided into many tubes, ſo minute that they could ſcarcely be perceived, and that the urine paſſed into their cavities.

The experience and obſervations of moſt anatomiſts are contrary to this ſuppoſed diſcovery. They admit there is a kind of ligament which adheres by one end to the external ſurface of the bottom of the bladder, and extends to the navel; but it becomes ſo delicate, on entering into the cord, as to be nearly reduced to nothing: in common this ligament is not hollow, and we can ſee no orifice at the bottom of the bladder.

The fœtus has no communication with the open air, and the experiments made upon the lungs prove they have never reſpired ; for they ſink to the bottom when put in water: whereas thoſe of infants who have breathed always float on the top ; the fœtus then does not reſpire in the womb, conſequently it cannot form any ſound by its voice ; and therefore what has been related of the groaning and crying of children before their birth may be conſidered as fables. After the flowing of the waters it may happen, that the air has found an entrance into the cavity of the matrix, and then the infant may begin to reſpire before it is brought forth. In this caſe it may be able to cry, as the chicken cries before the ſhell of the egg is broken, which it can do from there being air in the cavity which is between the external membrane and the ſhell. This air is found in all eggs, and is produced by the internal fermentation of matters contained in them *.

The lungs of the fœtus being without any motion, have no more blood enter into them than is requiſite to nouriſh and make them grow ; and there is another road opened for the courſe of its circulation. The blood in the right auricle of the heart, inſtead of paſſing into

---

* See La Statique des Vegetaux, Chap. vi.

into the pulmonary artery, and returning, after having ran through the lungs into the left auricle by the pulmonary vein, paſſes immediately into the left by an opening, called the *foremen ovale*, which is in the partition of the heart between the two auricles. It enters afterwards into the aorta, which diſtributes it by its ramifications, at going out of which the venous branches receive it, and bring it back to the heart by uniting all in the *vena cava*, which terminates at the right auricle of the heart. The blood which this auricle contains, inſtead of paſſing entirely by the foremen ovale, may eſcape in part into the pulmonary and the aorta by an arterial canal, which goes immediately from the one to the other. It is by theſe roads that the blood of the fœtus circulates without entering into the lungs, as it enters into thoſe of children, adults, and every animal which breathes.

It has been thought that the blood of the mother paſſes into the body of the fœtus, by means of the placenta and umbilical cord. It was ſuppoſed that the ſanguinary veſſels of the matrix opened into the vacuities, and thoſe of the placenta into the nipples, and that they joined one to the other; but experience is quite contrary to this opinion; for if the arteries of the umbilical cord is injected the liquor returns by the veins, and not any part of it eſcapes externally. Beſides, the nipples may be drawn from the vacuities where they are lodged, without any blood iſſuing either from the matrix or placenta: a milky liquor only iſſues from both, and which, we have already obſerved, ſerves the fœtus for nutriment. This liquor poſſibly enters into the veins of the placenta, as the chyle enters into the ſubclavian vein; and perhaps the placenta in a great meaſure performs the office of the lungs in bringing the blood to maturity. It is certain that the blood appears much ſooner in the placenta than in the fœtus, and I have often obſerved in eggs that have been under the hen for a day or two, that the blood appeared at firſt in the membranes, and that their ſanguinary veſſels are very large and numerous, while the whole body of the chicken, excepting the point where theſe blood-veſſels terminate, is only a white and almoſt tranſparent matter, in which there is not the ſmalleſt ſign of a ſanguinary veſſel.

It has been imagined, that the liquor of the amnios is a nutriment the fœtus receives

ceives by its mouth. Some naturaliſts pretend to have obſerved this liquor in the ſtomach, and to have ſeen ſome fœtuſſes to which the umbilical cord was entirely wanting, and others who had but a very ſmall portion, which did not at all adhere to the placenta: but in this caſe might not the liquor have entered into the body of the fœtus by the ſmall portion of the umbilical cord, or by the umbilical veſſel itſelf? beſides, to theſe obſervations we may oppoſe others. Some fœtuſſes have been found whoſe lips were not ſeparated, and others without any opening in the œſophagus. To conciliate theſe circumſtances, ſome anatomiſts have thought that the aliments paſſed into the fœtus partly by the umbilical cord, and partly by the mouth: none of theſe opinions appear to have any foundation. It is not the queſtion to examine the growth of the fœtus alone, and to ſeek from whence and by what it draws its nutriment, but how the growth of the whole is made; for the placenta, liquor, and membranes increaſe in ſize as well as in the fœtus; and conſequently the inſtruments and canals employed to receive or carry this nutriment to the fœtus, have a kind of life themſelves. The expanſion of the placenta and membranes is as difficult to conceive as that of the fœtus; and we might ſay, with equal propriety, that the fœtus nouriſhes the placenta, as that the placenta nouriſhes the fœtus. The whole maſs is floating in the matrix, and without any adherence, at the commencement of this growth: therefore the nouriſhment can be only made by an abſorption of the milky matter contained in the matrix. The placenta appears firſt to draw this nutriment, to convert this milk into blood, and to carry it to the fœtus by veins. The liquor of the amnios appears to be only this milky liquor depurated, the quantity of which increaſes by a like abſorption, proportionate to the increaſe of the membranes, and the fœtus probably abſorbs this liquor, which appears to be the neceſſary nutriment for its expanſion. For we muſt obſerve, that for the firſt two or three months the fœtus contains very little blood; it is as white as ivory, and appears to be compoſed of lymph which has taken ſome ſolidity; and as the ſkin is tranſparent, and all the parts very ſoft, we may eaſily conceive that the liquor in which the fœtus ſwims may penetrate them, and thus furniſh the neceſſary matter for its nutrition and expanſion. It may be ſuppoſed that the fœtus in the latter ſtages takes its nutriment by the mouth, ſince in the ſtomach we find a liquor ſimilar to that in the amnios, urine in the bladder, and excrements in the inteſtines; and as we find neither urine nor *meconium* in the amnios, there is reaſon to conclude that the fœtus does not void its excrements, eſpecially as ſome are born without having the anus pierced, although they had a great quantity of *meconium* in the inteſtines.

Although the fœtus does not immediately adhere to the matrix, but is only attached to it by ſmall external nipples, though it has no communication with the blood of its mother, but is as independent of her who bears it, in many reſpects, as the egg is of the hen that hatches it, yet it has been pretended, that all which affects the mother affects the fœtus; that the impreſſions of the one acts on the brain of the other; and to this imaginary influence reſemblances, monſters, and eſpecially marks on the ſkin of ſome children, have been attributed. I have examined many of theſe marks, and they all appeared to me to have been cauſed by a derangement in the texture of the ſkin. Every mark muſt have a figure which will reſemble ſomething or other; but I am certain the reſemblances ſo formed depends rather on the imagination of thoſe who ſee them than on that of the mother. On this ſubject the marvellous has been carried as far as it could go. It has not been only ſaid that the fœtus carried real repreſentations of the longings of its mother, but that, by a ſingular ſympathy, the marks, which repreſent ſtrawberries, cherries, &c. change their colour, and become deeper in the ſeaſon of thoſe fruits. With a little more conſideration, and leſs prejudice, this colour may be ſeen to change much oftener, and that it muſt happen every time the motion of the blood is accelerated, whether by the heat of ſummer or from any other cauſe. Theſe marks are either yellow, red, or black, becauſe the blood gives theſe tints to the ſkin when it enters in too great quantities into the veſſels. If theſe marks have the longings of the mother for their cauſe, why have they not the forms and colours as varied as the objects of her deſires? What a curious aſſemblage of figures would be ſeen if all the whimſical deſires of the mother were written on the ſkin of the child?

As our ſenſations have no reſemblance to the objects which cauſe them, it is impoſſible that deſire, fear, horror, or any paſſion, or internal emotion, can produce real repreſentations of thoſe objects; and the child being in this reſpect as independent of the mother as the egg is of the hen, I ſhould as ſoon believe that a hen, which ſaw the neck of a cock twiſted, would hatch chickens with wry necks, as that, by the power of imagination, a woman, who happened to ſee a man broke upon the wheel, would bring forth a child with its limbs broken in the ſame manner.

But even ſuppoſing this circumſtance atteſted, I ſhould ſtill ſupport the opinion, that the imagination of the mother had not been the cauſe, for what is the effect of horror? an internal motion, a convulſion in the body of the mother, which might ſhake, compreſs, and agitate the womb. What can reſult from this commotion? nothing ſimilar to the cauſe, for if this commotion was very violent the fœtus might be killed, wounded, or deformed in ſome of its parts; but how is it to be conceived that this commotion can produce any thing reſembling the fancy of the mother in the fœtus, unleſs we believe, with Harvey, that the matrix has the faculty of conceiving ideas, and realizing them on the fœtus?

But, it may be urged, if it was not affected by the imagination of the mother, why did the child come into the world with broken limbs? However raſh it may appear to explain a matter which is extraordinary and uncertain, and of which we have no right to exact a ſolution, yet this queſtion appears to me anſwerable in a ſatisfactory manner. Circumſtances of the moſt rare and extraordinary kind happen as neceſſarily as thoſe which are frequent and common. In the infinite combinations which matter can take, the moſt extraordinary arrangements muſt ſometimes happen; hence we might venture to wager, that in a million, or a thouſand millions of children, there will be one born with two heads, four legs, or with broken limbs; it may, therefore, naturally happen, without the concurrence of the mother's imagination, that a child ſhould be born with broken limbs. This may have happened more than once, and the mother, while pregnant, might have been preſent at the breaking on the wheel, and therefore the defect of the child's formation has been attributed to what ſhe had ſeen, and to her impreſſed imagination. But, independent of this general anſwer, we may give a more direct explanation. The fœtus, as we have ſaid, has nothing in common with the mother; its functions, organs, blood, &c. are all particular, and belong to itſelf; the only thing which it derives from its mother is the liquor, or nutritive lymph, which filtrates from the matrix. If this lymph is bad, or envenomed with the venereal virus, the child will be alike diſordered; and it may be imagined, that all the diſeaſes which proceed from vitiated humours may be communicated from the mother to the child. We know that the ſmall-pox is communicative, and we have but too many examples of children who are, directly after their birth, the victims of the debauches of their parents. The venereal virus attacks the moſt ſolid parts of the bones, and it appears to act with more force towards the middle of the bone, where oſſification commences; I conceive, therefore, that the child here ſpoken of has been attacked by the venereal diſorder while in its mother's womb, and from that cauſe it came into the world with its bones broken through the middle.

Rickets may alſo produce the ſame effect. There is a ſkeleton of a rickety child in the French king's cabinet, whoſe arms and legs have calloſities in the middle of their bones.

By the inſpection of this ſkeleton, it appeared evident that the bones had been broken during the time it was in the womb, and that afterwards the bones re-united, and formed theſe calloſities.

But enough of a ſubject which credulity alone has rendered marvellous. Prejudice, eſpecially that ſort which is founded on the marvellous, will always triumph over reaſon, and we ſhould have but little philoſophy if we were aſtoniſhed at it. We muſt not therefore ever expect to be able to perſuade women, that the marks on their children have no connection with their unſatisfied longings. Yet might it not be aſked them, before the birth of the child, of what particular longings they had been diſappointed, and conſequently what will be the marks their children will bear? I have often aſked this queſtion, and have only made perſons angry without having ever convinced them.

The time that a woman goes with child is generally about nine months; but it is however ſometimes longer and ſometimes ſhorter. Many children are born at ſeven or eight months, and ſome not till after the ninth; but in general the deliveries which precede the term of nine months are more frequent than the others. The common time of a natural delivery extends to twenty days, that is, from eight months fourteen days to nine months and four hours.

Many children are born before the 260th day, and although theſe deliveries precede the general term, they are not abortions, becauſe theſe children moſtly live. It is commonly thought that children born at eight months cannot live, or at leaſt that many more of them die than of thoſe born at ſeven months. This opinion appears to be a paradox; and by conſulting experience I think we ſhall find it an error. The child brought forth at eight months is more formed, and conſequently more vigorous, and likely to live than that which is born at the ſeventh. Nevertheleſs this opinion is pretty generally received, and founded on the authority of Ariſtotle.

The beginning of the ſeventh month is the earlieſt term for delivery; if the fœtus is brought forth ſooner it dies, and is termed an abortion. There are, however, great limits for the time of human delivery, ſince they extend from the ſeventh to the tenth, and perhaps to the eleventh month.

Women who have had many children aſſert, that girls remain longer in the womb than boys. If this is really the caſe, we muſt not be ſurprized at female children being born at ten months. When children come before nine months they are not ſo well proportioned as thoſe who are not brought into the world till ten months, the bodies of the latter are ſenſibly larger and better formed; their hair is longer, the growth of the teeth, although ſtill hid under the gums, is more advanced; the voice is clearer, and the tone more deep.

There is much uncertainty on the occaſional cauſes of delivery, and we do not perfectly know what obliges the infant to quit the womb. Some imagine, that the fœtus having acquired a certain ſize, the matrix is too confined for its longer ſtay, and that the conſtraint felt by the fœtus obliges it to uſe every effort to quit its priſon; others ſay, and it is nearly to the ſame purport, that the weight of the fœtus becomes ſo great, that the matrix is forced to open to free itſelf from the burthen. Theſe reaſons do not appear ſatisfactory; for the matrix muſt always have capacity and ſtrength to contain and ſuſtain the weight of a fœtus of nine months, ſince it often contains two, and it is certain that the weight and ſize of twins of eight months are more conſiderable than the weight and ſize of a ſingle child of nine. Beſides, it often happens that a child born at nine months is ſmaller than the fœtus of eight months, although it continues in the womb.

Galen pretends, that the child remains in the matrix till it is able to receive its food by the mouth, and that it only forces its eſcape from the need of nutriment. Others have ſaid, that the fœtus always receives its nouriſhment by the mouth from the liquor of the amnios; but which becomes at length ſo contaminated, by the tranſpiration and urine of the fœtus, that it becomes diſguſtful, and obliges the fœtus to uſe every exertion to quit its confinement. Theſe reaſons do not appear better than the firſt; for it would from thence follow, that the weakeſt and ſmalleſt fœtuſſes would remain longer in the womb than the ſtrongeſt and largeſt, which never happens; beſides, it is not food that the fœtus ſeeks immediately after it is born, for it can ſtay ſome time without it; on the contrary, it ſeems moſt deſirous to diſembarraſs itſelf from the nutriment it took when in the womb of its mother, and to return the meconium. Other anatomiſts have ſuppoſed that the excrements accumulated in the bowels of the fœtus, gives it great pain, and cauſes it to make ſuch efforts, that the matrix is at length obliged to give way, and to open a paſſage for its eſcape. I acknowledge I am not better ſatisfied with this explanation than the reſt; becauſe, why cannot the fœtus void its excrements in the amnios, if it was preſſed ſo to do? Now this never happens; it appears, on the contrary, that this neceſſity of voiding the meconium is not felt till after the birth, when the motion of the diaphragm, occaſioned by that of the lungs, compreſſes the inteſtines and cauſes this evacuation; for the meconium has never been found in the amnios of a fœtus of ten months who had not reſpired, whereas a fœtus of ſix or ſeven months voids this meconium a ſhort time after reſpiration.

Other anatomiſts, and among them Fabricius de Aquapendente, have ſuppoſed the fœtus quitted the matrix through the need of procuring refreſhment by means of reſpiration. This cauſe appears to me ſtill more remote than all the reſt, becauſe the fœtus can have no idea of reſpiration without having reſpired.

After having weighed all theſe explanations, I ſuppoſe the fœtus's quitting the matrix depends on a quite different cauſe. The flowing of the menſtrua is periodical, and at determined intervals; and although conception ſuppreſſes its appearance, it does not deſtroy the cauſe; for notwithſtanding the blood does not appear at the accuſtomed times, yet a kind of revolution takes place, like that which is made before conception. Thus it is, there are many women whoſe menſtrua are not ſuppreſſed in the firſt two or three months. I imagine, therefore, that when a woman has conceived, the periodical revolution is made as regular as before; but as the matrix is ſwelled, the excretory canals cannot give iſſue to the blood, at leaſt unleſs it arrives there with ſuch force, and in ſuch quantities, as to open a paſſage in ſpite of the reſiſtance that is oppoſed to it. In this caſe blood will appear, and if it flows in a great quantity abortion will enſue, and the matrix retake the form it had before. But if the blood only forces one part of theſe canals, the buſineſs of generation will not be deſtroyed, although the blood appears, becauſe the greateſt part of the matrix ſtill remains in the ſtate which is neceſſary for that purpoſe.

When no blood appears, as is generally the caſe, the firſt periodical revolution is remarkable and felt by the ſame pains and ſymptoms. From the firſt ſuppreſſion of the menſes, therefore, a violent action on the matrix is made, and provided the action is augmented, it deſtroys the product of generation. It may from thence be concluded, that every conception which is made juſt before the uſual return of the menſes ſeldom ſucceeds, and that the action of that blood eaſily deſtroys the weak roots of a germ ſo tender and ſo delicate. The conceptions, on the contrary, which are made juſt after the periodical evacuations ſucceed the beſt, becauſe the produce of the conception has more time to grow, ſtrengthen, and reſiſt the action of the blood, by the time the next revolution happens.

The fœtus having undergone this firſt trial, and having reſiſted it, receives more ſtrength and growth, and is more in a condition to contend againſt the ſucceeding revolutions. Miſcarriages may and do happen in all the periodical revolutions; but they are leſs frequent in the fourth or fifth months, than either at the beginning or near the end. We have aſſigned the reaſons why they are more frequent at the beginning; it therefore only remains to explain why they are alſo more frequent towards the end.

The fœtus generally comes into the world during the tenth revolution. When it is born at the eighth or ninth it lives, and theſe deliveries are not looked upon as miſcarriages, becauſe the child, although not ſo perfectly formed, is ſtill ſufficiently ſo for the purpoſe of life. It has been pretended, that examples have been ſeen of children born at the ſeventh and even at the ſixth revolution, that is, at five or ſix months, which have lived. There is, therefore, no difference between a birth and a miſcarriage but what is relative to the living powers of the infant. In general the number of miſcarriages in the firſt, ſecond, and third months are very conſiderable for the reaſons we have given; and the number of deliveries of the ſeventh and eighth months are alſo very great, in compariſon with the miſcarriages of the fourth, fifth, and ſixth months, becauſe in this middle period the product of generation has received more ſolidity and ſtrength, and having reſiſted the action of the four firſt periodical revolutions, a more violent force than the preceding is required to deſtroy it. The ſame reaſon ſubſiſts, with additional force, for the fifth and ſixth months. But the fœtus, which till then is weak, and can act only by its own feeble ſtrength, begins to get ſtrong, and move with vigour ; and at the eighth revolution the fœtus, uniting its efforts with thoſe of the matrix, facilitates its excluſion, and it may come into the world in the ſeventh month, and be capable of living, eſpecially if it happens, as is ſometimes the caſe, to have more than ordinary ſtrength for that period. But if it comes into the world only through the weakneſs of the matrix, which could not reſiſt the action of the blood in this eighth revolution, the delivery would be regarded as a miſcarriage, and the child would not live. But theſe caſes are very rare, for if the fœtus has reſiſted the ſeven firſt revolutions, only particular accidents can prevent it from reſiſting the eighth. The fœtus, which has acquired this ſame degree of ſtrength and vigour only a little later, will come into the world at the ninth revolution; and thoſe which require nine months to obtain this ſame ſtrength, will come at the tenth revolution, which is the moſt common and general term; but when the fœtus has not acquired in nine months this degree of perfection, it may remain in the womb till the eleventh, and even till the twelfth revolution; that is, till the tenth or eleventh month, as we have many examples.

This opinion, that it is the menſtrua which is the occaſional cauſe of delivery at different times, may be confirmed by many other reaſons. The females of every animal which have no menſes, bring forth at nearly the ſame terms, and there is but a very ſlight variation in the duration of their geſtation. We may, therefore, ſuppoſe that this variation, which is ſo great in women, comes from the action of the menſtrual blood, which is conſtantly exerted at every periodic return.

We have obſerved, that the placenta adheres to the papillæ, or the matrix, only by nipples; that there is no blood either in theſe nipples or in the vacuities they are niched into, and that when they are ſeparated (which is eaſily done) a milky liquor only iſſues from them. Now, how happens it that delivery is always accompanied with a conſiderable hæmorrhage, at firſt of pure blood, and afterwards mixed with a watery liquor. This blood does not proceed from the ſeparation of the placenta, as the nipples are drawn out without any effuſion of blood? Delivery, which entirely conſiſts of this ſeparation, ſhould not, therefore, produce any blood. Is it not then more accordant with reaſon to ſuppoſe, that it is the action of the blood which cauſes delivery, and that it is this menſtrual blood which forces the veſſels as ſoon as the matrix is emptied, and which begins to flow immediately after delivery as it did before conception?

It is known, that in the firſt months of pregnancy that which contains the ſeed of generation is not adherent to the matrix. By the experiments of De Graaf it has been ſeen, that by blowing on the little ball we can make it move. The adheſion to the matrix is never very ſtrong, and at firſt the placenta with difficulty adheres to the internal membrane of the viſcera, and thoſe parts are only contiguous, or joined by a mucilaginous matter, which has ſcarcely any adheſion. Why then does it occur, that in miſcarriages of the firſt and ſecond month this ball never eſcapes without a great effuſion of blood? It is certainly not cauſed by the paſſage of the ball quitting the matrix, ſince it does not adhere to it; but it is, on the contrary, by the action of this blood that the ball is driven out. Muſt we not then con-conclude this blood to be menſtrual, which by forcing the canals, through which it had been accuſtomed to paſs before impregnation, deſtroys the product of conception by retaking its common road?

It appears, therefore, that the periodical revolution of the menſtrual blood has great influence on delivery, and that it is the cauſe why the times of delivery in women vary ſo much more than in every other female who is not ſubject to the periodical evacuation, and which always bring forth at the ſame times. It alſo appears that this revolution, occaſioned by the action of the menſtrual blood, is not the ſole cauſe of birth, but that the action of the fœtus itſelf contributes towards it, ſince there are inſtances of a child eſcaping from the womb after the death of the mother, which neceſſarily ſuppoſes an action proper and particular in itſelf.

The ſpace of time which cows, ſheep, and other animals go with young is always the ſame, and their deliveries are not attended with an hæmorrhage. May we not then conclude, that the blood voided by women after delivery is the menſtrual blood, and that the human fœtus being born at ſuch different terms, can only be by the actions of this blood on the matrix during every periodical revolution? It is natural to imagine, that if the females of viviparous animals had menſes like women, their deliveries would be followed with an effuſion of blood, and happen at different terms. The fœtuſſes of animals come into the world cloathed with their membranes (and it ſeldom happens that the membranes are broken), and the waters flow before the delivery; whereas it is very rare a child is brought forth with its membranes entire. This ſeems to prove that the human fœtus makes more efforts than other animals to quit its priſon; or that the matrix of a woman does not ſo naturally incline to the paſſage of the child, for it is the fœtus which tears its membranes, by the efforts it makes againſt the reſiſtance it meets with at the orifice of the viſcera.

RECAPITULATION.

ALL animals procure nutriment from vegetables, or other animals which feed upon vegetables; there is, therefore, one common matter to both, which ſerves for the nutrition and expanſion of every thing which lives or vegetates. This matter cannot perform them but by aſſimilating itſelf to each part of the animal or vegetable, and by intimately penetrating the texture and form of theſe parts, which I have called the *internal mould.* When this nutritive matter is more abundant than is neceſſary to nouriſh and expand the animal or vegetable, it is ſent back from every part of the body, and depoſited in one or more reſervoirs, in the form of a liquor; this liquor contains all the molecules analogous to all parts of the body; and conſequently all that is neceſſary for the reproduction of a young being, perfectly reſembling the firſt. Commonly this nutritive matter does not become ſuperabundant, in moſt kinds of animals, till they have acquired the greateſt part of their growth; and it is for this reaſon that animals are not in a ſtate of engendering before that time.

When this nutritive and productive matter, which is univerſally ſpread abroad, has paſſed through the internal mould of an animal or vegetable, and has found a proper matrix, it produces an animal or vegetable, of the ſame kind; but when it does not meet with a proper matrix, it produces organized beings different from animals and vegetables, as the moving and vegetating bodies ſeen in the ſeminal liquor of animals, in the infuſion of the germ of plants, &c.

This productive matter is compoſed of organic particles, always active, the motion and action of which are fixed by the inanimate parts of matter in general, and particularly by oily and ſaline bodies, but as ſoon as they are diſengaged from this foreign matter, they retake their action, and produce different kinds of vegetations and other animated beings.

By the microſcope, the effects of this productive matter may be perceived in the ſeminal liquors of animals of both ſexes. The ſeed of the female viviparous animals is filtered through the glandular bodies which grow upon their teſticles, and theſe glandular bodies contain a large quantity of ſeminal fluid in their internal cavities. Oviparous females have, as well as the viviparous, a ſeminal liquor, which is ſtill more active than the viviparous. The ſeed of the female is in general like that of the male, when they are both in a natural ſtate: they decompoſe after the ſame manner, contain ſimilar organic bodies, and they alike offer the ſame phenomena.

All animal or vegetable ſubſtances include a great quantity of this organic and productive matter. To perceive it, we need only ſeparate the inanimate parts in which the active particles of this matter are engaged. And this is done by infuſing animal or vegetable ſubſtances in water. The ſalts will diſſolve, the oils ſeparate, and the organic particles will be ſeen by their putting themſelves in motion. They are in greater abundance in the ſeminal liquors than in any other parts, or rather, they are leſs entangled by the inanimate parts. In the beginning of this infuſion, when the fleſh is but ſlightly diſſolved, the organic matter is ſeen under the form of moving bodies, which are almoſt as large as thoſe of the ſeminal liquors: but, in proportion as the decompoſition augments, theſe organic particles diminiſh in ſize and increaſe in motion; and when the fleſh is entirely decompoſed, or corrupted, theſe ſame particles are exceedingly minute, and their motion exceedingly rapid. It is then that their matter may become a poiſon, like that of the tooth of a viper, wherein Mr. Mead perceived an infinite number of ſmall pointed bodies, which he took for ſalts, although they are only theſe ſame organic particles in a ſtate of great activity. The pus which iſſues from wounds abounds with little inſects, and it may take ſuch a degree of corruption as to become one of the moſt ſubtle poiſons; for every time this active matter is exalted to a certain point, which may be known by the rapidity and minuteneſs of the moving bodies it contains, it will become a ſpecies of poiſon. It is the ſame with the poiſon of vegetables. The ſame matter which ſerves to feed us when in its natural ſtate, will deſtroy us when corrupted. Spurred barley, for inſtance, throws the limbs of men and animals into a gangrene who feed on it. It is alſo evident by comparing the matter which adheres to our teeth, which is the reſidue of our food, with that from the teeth of a viper or mad dog, which is only the ſame matter too much exalted and corrupted to the laſt degree.

When this organic and productive matter is found collected in a great quantity in ſome part of an animal, where it is obliged to remain, it forms living beings which have been ever regarded as animals; the tænia, aſcarides, all the worms found in the veins, liver, in wounds, in corrupted fleſh, and pus, have no other origin; the eels in paſte, vinegar, and all the pretended microſcopical animals are only different forms which this active matter takes of itſelf, according to circumſtances, and which invariably tends to organization.

In all animal and vegetable ſubſtances, decompoſed by infuſion, this productive matter manifeſts itſelf immediately under the form of vegetation. Filaments are ſeen to form, which grow and extend like plants. Afterwards theſe extremities and knots ſwell and burſt, to give paſſage to a multitude of bodies in motion, which appear to be animals; ſo that it ſeems as if all nature began by a motion of vegetation. It is ſeen by microſcopical objects, and likewiſe by the expanſion or unfolding of the animal embryo; for the fœtus at firſt has only a ſpecies of vegetable motion.

Sound food does not furniſh any of theſe moving molecules for a conſiderable time. Several days infuſion in water is required for freſh meat, grain, kernels, &c. before they offer to our ſight any moving bodies; but the more matters are corrupted, decompoſed, or exalted, the more ſuddenly theſe moving bodies manifeſt themſelves; they are all free from other matters in ſeminal liquors; but a few hours infuſion is required to ſee them in pus, ſpurred barley, honey, drugs, &c.

There exiſts, therefore, an organic matter, univerſally diffuſed in all animal and vegetable ſubſtances, which alike ſerves for their nutrition, their growth, and their reproduction. Nutrition is performed by the intimate penetration of this matter in all parts of the animal or vegetable body. Expanſion or growth is only a kind of more extended nutrition, which is made and performed as long as the parts have ſufficient ductility to ſwell and extend; and reproduction is made by the ſame matter when it ſuperabounds in the body of the animal or vegetable; each part of the body ſends back, to the appropriate reſervoirs, the organic particles which exceed what are ſufficient for their nouriſhment. Theſe particles are abſolutely analogous to each part from which they are ſent back, becauſe they were deſtined to nouriſh thoſe parts from hence, when all the particles ſent back from, collect together, they muſt form a body ſimilar to the firſt, ſince each particle is like that part from which it was detached; thus it is that reproduction is effected in all kinds of trees, plants, polypuſſes, pucerons, &c. where one individual can produce its like; and it is alſo the firſt mode which Nature uſes for the reproduction of animals which have need of the communication of different ſexes; for the ſeminal liquors of both ſexes contain all the neceſſary molecules for reproduction; but ſomething more is required for its effectual completion, which is the mixture of theſe two liquors in ſome places ſuitable to the expanſion of the fœtus which muſt reſult therefrom, which place is the matrix of the female.

There are, therefore, no pre-exiſting germs, no germs contained one in the other, *ad infinitum*; but there is an organic matter perpetually active, and always ready to form, aſſimilate, and produce beings ſimilar to thoſe which receive it. Animals and vegetables, therefore, can never be extinct; ſo long as there ſubſiſts individuals the ſpecies will ever be new; they are the ſame at preſent as they were three thouſand years ago, and will perpetually exiſt, by the powers they are endowed with, unleſs annihilated by the will of the Almighty Creator.

HISTORY OF MAN.

CHAPTER I.

OF THE NATURE OF MAN.

THOUGH ſo much intereſted in acquiring a thorough knowledge of ourſelves, yet I do not know if man is not leſs acquainted with the human, than with any other exiſtence. Provided by nature with organs, calculated ſolely for our preſervation, we only employ them to receive foreign impreſſions. Intent on multiplying the functions of our ſenſes, and on enlarging the external bounds of our being, we rarely make uſe of that internal ſenſe which reduces us to our true dimenſions, and abſtracts us from every other part of the creation. It is, however, by a cultivation of this ſenſe alone that we can form a proper judgment of ourſelves. But how ſhall we give it its full activity and extent? How ſhall the ſoul, in which it reſides, be diſengaged from all the illuſions of the mind? We have loſt the habit of employing this ſenſe; it has remained inactive amidſt the tumult of our corporeal ſenſations, and dried up by the heat of our paſſions; the heart, the mind, the ſenſes, have all co-operated againſt it.

Unalterable in its ſubſtance, and invulnerable by its eſſence, it ſtill, however, continues the ſame. Its ſplendor has been overcaſt, but its power has not been diminiſhed: it may be leſs luminous, but its guidance is not the leſs certain. Let us then collect thoſe rays, of which we are not yet deprived, and its obſcurity will decreaſe; and though the road may not in every part be equally filled with light, we yet ſhall have a torch that will prevent us from going aſtray.

The firſt and moſt difficult ſtep which leads to the knowledge of ourſelves, is a diſtinct conception of the two ſubſtances that conſtitute our being. To ſay ſimply, that the one is unextended, immaterial, and immortal, and that the other is extended, material, and mortal, is only to deny to the one, what we affirm the other poſſeſſes. What knowledge is to be acquired from this mode of negation? Such negative expreſſions can exhibit no poſitive ideas: but to ſay that we are certain of the exiſtence of the former, and that of the latter is leſs evident; that the ſubſtance of the one is ſimple, indiviſible, and has no form, ſince it only manifeſts itſelf by a ſingle modification, which is thought; that the other is a leſs ſubſtance than a ſubject, capable of receiving different forms, which bear a relation to our ſenſes, but are all as uncertain and variable as the organs themſelves; that is to ſay ſomething; it is to aſcribe to each ſuch diſtinct and poſitive properties as may lead us to an elemental knowledge of both, and to a compariſon between them.

From the ſmalleſt reflection on the origin of our knowledge, it is eaſy to perceive that it is by compariſon alone we acquire it. What is abſolutely incomparable, is utterly incomprehenſible; of this God is the only example; he exceeds all comprehenſion, becauſe he is above all compariſon. But whatever is capable of being compared, contemplated, and conſidered relatively, in different lights, may always come within the ſphere of our underſtanding. The more ſubjects of compariſon we have for examining any object, the more methods there are for obtaining a knowledge of it, and with greater facility.

The exiſtence of the ſoul is fully demonſtrated. To be and to think are with us identically the ſame. This truth is more than intuitive; it is independent of our ſenſes, of our imagination, of our memory, and of all our other relative faculties. The exiſtence of our bodies, and of external objects, is however held in uncertainty by every unprejudiced reaſoner; for what is that extenſion of length, breadth, and thickneſs, which we call our body, and which ſeems to be ſo much our own, but as it relates to our ſenſes? What are even the material organs of thoſe ſenſes, but ſo many conformities with the objects that affect them? And with regard to our internal ſenſe, has it any thing ſimilar or in common with theſe external organs? Have the ſenſations excited by light or ſound any reſemblance to that tenuous matter, which ſeems to diffuſe light, or to that tremulous undulation which ſound produces in the air? The effects are certainly produced by the neceſſary conformity there is between the eyes and ears, and thoſe matters which act upon them. Is not that a ſufficient proof that the nature of the ſoul is different from that of matter.

It is then a certain truth, that the internal ſenſation is altogether different from its cauſe; as alſo, if external objects exiſt, they are in themſelves very different from what we conceive them. As ſenſation therefore bears no reſemblance to the thing by which it is excited, does it not follow that the cauſes of our ſenſations neceſſarily differ from our ideas of them? The extenſion which we perceive by our eyes, the impenetrability, of which we receive an idea by the touch all thoſe qualities, whoſe various combinations conſtitute matter, are of a doubtful exiſtence; ſince our internal ſenſations of extenſion, impenetrability, &c. are neither extended nor impenetrable, and have not even the ſmalleſt affinity with thoſe qualities.

The mind being often affected with ſenſations during ſleep, very different from thoſe which it has experienced by the preſence of the ſame objects, does it not lead to a belief that the preſence of objects is not neceſſary to the exiſtence of our ſenſations; and that of conſequence our mind and body may exiſt independent of thoſe objects? During ſleep, and after death, for example, our body has the ſame exiſtence as before; yet the mind no longer perceives this exiſtence, and the body with regard to us, has ceaſed to be. The queſtion is therefore, whether a thing which can exiſt, and afterwards be no more, and which affects us in a manner altogether different from what it is, or what it has been, may yet be a reality of indubitable exiſtence.

That ſomething exiſts without us we may believe, though not with a poſitive aſſurance; whereas of the real exiſtence of every thing within us we have a certainty. That of our ſoul, therefore, is inconteſtible, and that of our body ſeems doubtful; becauſe the mind has one mode of perception when we are awake, and another when we are aſleep; after death, it will perceive by a method ſtill more different, and the objects of its ſenſations, or matter in general, may then ceaſe to exiſt with reſpect to it, as well as our bodies, with which we have no farther connection.

But let us admit this exiſtence of matter, and that it even exiſts as it appears to our ſenſes; yet by comparing the mind with any material object, we ſhall find differences ſo great, and qualities ſo oppoſite, that every doubt will vaniſh of the latter being of a nature totally different, and infinitely ſuperior.

The mind has but one form, which is ſimple, general, and uniform. Thought is this form; has nothing in it of diviſion, extenſion, impenetrability, nor any other quality of matter; of conſequence, therefore, our mind, the ſubject of this form, is indiviſible and immaterial. Our bodies, on the contrary, and all other objects have many forms, each of which is compounded, diviſible, variable, and periſhable; and has a relation to the different organs through which we perceive them. Our bodies, and matters in general, therefore, have neither permanent, real, nor general properties, by which we can attain a certain knowledge of them. A blind man has no idea of thoſe objects which ſight repreſents to us; a leper, whoſe ſkin has loſt the ſenſe of feeling, is denied all the ideas which ariſe from the touch; and a deaf man has no knowledge of ſounds. Let theſe three modes of ſenſation be ſucceſſively deſtroyed, yet the mind will exiſt, its internal functions will ſubſiſt, and thought will ſtill manifeſt itſelf within the man ſo deprived. But diveſt matter of all its qualities, ſtrip it of colour, of ſolidity, and of every other property which has any relation to our ſenſes, and the conſequence will be its annihilation. Our mind then is unperiſhable, but matter may and will periſh.

It is the ſame with all the other faculties of our ſoul when compared with the moſt eſſential properties of matter. As the mind wills and commands, ſo the body obeys in every thing within its power. The mind forms at pleaſure an intimate union with any object; neither diſtance, magnitude, nor figure, can obſtruct this union, when the mind wills it, it is effected in an inſtant. The body can form no union; whatever touches it too cloſely injures it; it requires a long time in order to approach another body; it every where meets with reſiſtance and obſtacles, and from the ſmalleſt ſhock its motion ceaſes. Is will then nothing more than a corporeal movement? and is contemplation but a ſimple contact? How could this contact takes place upon a remote object or abſtracted ſubjects? How could this movement be accompliſhed in an indiviſible inſtant? Is it poſſible to have a conception of motion without having a conception of ſpace and time? Will, therefore, if it be a motion, is not a material one; and if the union of the mind with its object be a contact, it is effected at a diſtance; and is not this contact a penetration? qualities which are abſolutely oppoſite to thoſe of matter, and which of conſequence can only belong to an immaterial being.

But I fear I have already dwelt too long on a ſubject which by many may be conſidered as foreign to our purpoſe; and it might be aſked, "Ought Metaphyſical Conſiderations on the Soul to find a place in a Syſtem of Natural Hiſtory?" Were I conſcious of abilities equal to the diſcuſſion of a topic ſo exalted, this reflection, I muſt own, would have little weight with me; and I have contracted my remarks only becauſe I was afraid I ſhould not be able to comprehend a ſubject ſo enlarged and ſo important in its full extent. Why retrench from the Natural Hiſtory of Man the hiſtory of his nobleſt part? Why thus prepoſterouſly debaſe him, by conſidering him merely as an animal, while he is of a nature ſo different, and ſo ſuperior, to that of the brutes, that thoſe muſt be immerſed in ignorance, like the brutes themſelves, who ever thought of confounding them.

Man, as to the material part of his exiſtence, certainly bears a reſemblance to other animals, and in comprehending the circle of natural beings there is a neceſſity for placing him in the claſs of animals. Nature, however, has neither claſſes nor ſpecies; it contains only individuals. Theſe ſpecies and claſſes are nothing but ideas which we have ourſelves formed and eſtabliſhed, and though we place man in one of ſuch claſſes we do not change his being; we do not derogate from his dignity; we do not alter his condition. In a word, we only place him at the head of thoſe who bear a ſimilitude to him in the material part of his being.

In comparing man with the animal we find in both an organized body, ſenſes, fleſh, blood, motion, and a multitude of other reſemblances. But theſe reſemblances are all external, and not ſufficient to juſtify a deciſion, that the human and the animal natures are ſimilar. In order to form a proper judgment of the nature of each we ought to have as diſtinct a knowledge of the internal qualities of an animal as we have of our own. As the knowledge of what paſſes within animals is impoſſible to be attained, and as we know not of what order and kind its ſenſations may be, in relation to thoſe of man, we can only judge from a compariſon of the effects which reſult from the natural operations of both.

Let us then take a view of theſe effects; and while we admit of all the particular reſemblances, limit our inveſtigation to the moſt general diſtinctions. It will be allowed that the moſt ſtupid man is able to manage the moſt acute animal; he governs it, and renders it ſubſervient to his purpoſes; and this not ſo much on account of his ſtrength or ſkill, as by the ſuperiority of his nature, and from his being poſſeſſed of reaſon, which enables him to form a rational ſyſtem of action and method, by which he compels the animals to obey him. The ſtrongeſt and moſt acute animals do not give law to the inferior, nor hold them in ſervitude. The ſtronger, it is true, devour the weaker, but this action implies no more than an urgent neceſſity, or a rage of appetite; qualities very different from that which produces a ſeries of actions, all tending to the ſame end. Did animals enjoy this faculty, ſhould we not ſee ſome of them aſſume dominion over others, and oblige them to furniſh their food, to watch over them, and to attend them when ſick or wounded? Now, throughout the creation of animals, there is no veſtige of ſuch ſubordination, no appearance that one of them knows, or is ſenſible of, the ſuperiority of his own nature over that of others. It follows then that they muſt all be conſidered as of one nature, and that the nature of man is not only highly ſuperior to that of the brute, but alſo entirely different from it.

Man, by outward ſigns, indicates what paſſes within him; he communicates his ſentiments by ſpeech, which is a ſign common to the whole human ſpecies. The ſavage and the civilized man have the ſame powers of utterance; both ſpeak naturally, and ſo as to be underſtood. No other animal is endowed with this expreſſion of thought; nor is that defect owing, as ſome have imagined, to the want of proper organs. Anatomiſts have found the tongue of an ape to be as perfect as that of a man. The ape, therefore, if he had thought, would have ſpeech, and if its thoughts had aught analogous to ours, this ſpeech would have an analogy to ours alſo. Suppoſing its thoughts were peculiar to its ſpecies, it ſtill would hold diſcourſe with thoſe of its kind, a circumſtance of which we ſhould have heard had it been endowed with the powers of ſpeech. So far then is the ape from having any thought like ours, that it has not even any order of thoughts of its own. As they expreſs nothing by combined and ſettled ſigns, they of conſequence are void of thought, or at moſt have it in a very ſmall degree.

That it is from no organical defect animals are denied the gift of ſpeech is plain, as ſeveral ſpecies of them may be taught to pronounce words, and even repeat ſentences of ſome length. Perhaps many others might be found capable of articulating particular ſounds [*]; but to make them conceive the idea which ſuch ſounds denote is an impracticable taſk. They ſeem to repeat and articulate merely as an echo, or an artificial machine. It is not in the mechanical powers, or the material organs, but in the intellectual faculties, that they are deficient.

---

[*] Leibnitz mentions a dog which had been taught to pronounce ſeveral German and French words.

As all language ſuppoſes a chain of thought, it is on that account that brute animals have no ſpeech, for even allowing ſomething in them which reſembles our firſt apprehenſions, our moſt groſs and mechanical ſenſations, they ſtill will be found incapable of forming that aſſociation of ideas which can alone produce reflection; and in this conſiſts the eſſence of thought. To this inability of connecting and ſeparating ideas it is that they are deſtitute of thought and ſpeech, as alſo that they neither can invent nor improve any thing. Were they endowed with the power of reflection, even in the moſt ſubordinate degree, they would be capable of making ſome kind of proficiency, and acquire more induſtry; the modern beaver would build with more art and ſolidity than the ancient; and the bee would daily be adding new improvements to its cell; for if we ſuppoſe this cell as perfect already as it can be, we aſcribe to the inſect an intelligence ſuperior to our own; by which it could diſcern at once the laſt degree of perfection to which its work might be carried, while we ourſelves are for ever in the dark as to this degree, and ſtand in need of much reflection, time, and practice, in order to perfect even one of our moſt trivial arts.

Whence can ariſe the uniformity that is in all the works of animals? Why does each ſpecies invariably perform the ſame actions in the ſame manner? And why does not one individual perform them better or worſe than another? Can there be a ſtronger proof that their operations are merely the effects of mechaniſm and materiality? If they poſſeſſed the ſmalleſt ſpark of that light which is inherent in mankind, their works would diſplay variety at leaſt, if not perfection, and one individual would, in its performances, make ſome little difference from what another had done. But this is far from being the caſe. One plan of action is common to the whole ſpecies, and whoever would attribute a mind or ſoul to animals, muſt of neceſſity allow but one to each ſpecies, of which each individual would be an equal partaker, and as thereby it would be diviſible, it would conſequently be material, and of a nature widely different from ours.

Why, on the other hand, are the productions and performances of men ſo various and ſo diverſified? Why is a ſervile imitation more troubleſome to us than an original deſign? It is becauſe our ſouls are our own, and independent of any other, and becauſe we have nothing in common with our ſpecies but the matter which forms our body, and in which our reſemblance to brute animals is confined.

Were internal ſenſations dependent on corporeal organs, ſhould we not ſee as remarkable differences in the works of animals of the ſame ſpecies as in thoſe of men? Would not thoſe which were the moſt happily organized, build their neſts and contrive their cells in a manner more ſolid, elegant, and commodious? And if any individual poſſeſſed of ſuperior genius, would it not take an opportunity to manifeſt that ſuperiority in its actions? But nothing of this kind has ever happened, and therefore the corporeal organs, however perfect or imperfect, have no influence on the nature of the internal ſenſations. Hence we may conclude, that animals have no ſenſations of this kind; that ſuch ſenſations have no connection with matter, no dependence in their nature on the texture of corporeal organs, and that of conſequence there muſt be a ſubſtance in man different from matter, which is the ſubject and the cauſe that produces and receives thoſe ſenſations.

But theſe proofs of the immateriality of the human mind may be carried ſtill farther. In all the works of nature there are imperceptible gradations maintained. This truth, which in no other inſtance admits of exception, is here expreſsly contradicted. Between the faculties of man and thoſe of the moſt perfect animal the diſtance is infinite; an evident proof that man is of a different nature from the brute ſpecies, and that of himſelf he forms a diſtinct claſs, between which and that of animals there is an immenſe chaſm. If man belonged to the claſs of animals, there would be a certain number of beings in nature leſs perfect than man, and more perfect than beaſt, in order to complete the gradation from a man to the monkey. But this is not the caſe; the tranſition is immediate from the thinking being to the material being; from intellectual faculties to mechanical powers; from order and deſign to blind motion; from reflection and choice to ſenſual appetite.

Enough has been here advanced to demonſtrate the excellence of our nature, and of the immenſe diſtance which the bounty of the Creator has placed between man and the brute. The former is a rational being, the latter a being devoid of reaſon. And as there is no medium between the poſitive and the negative, between the rational and irrational being, it is evident that man is of a nature entirely different from that of the animal; that all the reſemblance he bears to it is merely external; and that to judge of him by this reſemblance, is wilfully to ſhut our eyes againſt that light, by which we ought to diſtinguiſh truth from falſehood.

Having thus conſidered man as to his internal properties, and proved the immateriality of his ſoul; we ſhall now proceed to examine his external part, and give the hiſtory of his body. We have already traced him from his formation to his birth, and after taking a view of the different ages of his life, we ſhall conduct him to that period when he muſt be ſeparated from his body, and then reſign him to the common maſs of matter to which he belongs.

CHAPTER II.

OF INFANCY.

NOTHING can give us a more ſtriking idea of imbecillity, than the condition in which an infant appears on its firſt entrance into the world. Incapable of making uſe of its organs, or ſenſes, the infant is in want of every aſſiſtance. It is an image of pain and miſery; it is more helpleſs than the young of any other animal; it ſeems as if every moment would finiſh its doubtful exiſtence; it can neither move nor ſupport itſelf; hardly has it ſtrength enough to exiſt or announce, by its cries, the ſufferings it experiences; as if nature choſe to appriſe it, that it was born to ſuffer, and that it has obtained a place among the human ſpecies to partake of its infirmities and ſorrows.

Let us not diſdain to conſider that ſtate through which we have all paſſed: let us view human kind in the cradle; let us enquire by what degrees this delicate machine, this new-born and hardly exiſting body, acquires motion, conſiſtency, and ſtrength.

The infant at its birth comes from one element into another. On emerging from its watery reſidence in the womb, it becomes expoſed to the air, and inſtantly experiences the impreſſions of that active fluid. The air acts upon the olfactory nerves and upon the organs of reſpiration, and thereby produces a ſhock, a kind of ſneezing which expands the cheſt, and allows the air a paſſage into the lungs; the veſicles of which it dilates, and the air remaining for ſome time becomes warm and rarefied to a certain degree; after which the ſpring of the fibres thus dilated re-acts upon this light fluid, and expels it from the lungs. Inſtead of undertaking to explain the cauſes of the alternate motion of reſpiration, we ſhall confine ourſelves to an elucidation of its effects. This function is eſſential to the exiſtence of man and of ſeveral ſpecies of animals. It is by reſpiration that life is preſerved; and when it is once begun, it never ceaſes till death. Yet there is reaſon to believe that the foramen ovale is not cloſed immediately after the birth; and of conſequence a part of the blood may continue to paſs through that aperture. All the blood cannot, therefore, at firſt have a communication with the lungs; and it is probable a new-born child might ſuſtain a privation of air for a conſiderable time without loſing its exiſtence. Of at leaſt the poſſibility of this, I once ſeemingly confirmed by an experiment upon ſome young dogs. I put a pregnant bitch, of the large greyhound ſpecies, juſt as ſhe was about to litter, into a tub filled with warm water, where after faſtening her in ſuch a manner that the lower parts were covered with ſome water, ſhe brought forth three puppies, which were accordingly received into a liquid as warm as they had left. After waſhing them in this water, I removed the puppies, without giving them time to breathe, into a ſmaller tub filled with warm milk; I choſe milk in order that they might receive nouriſhment if they required it. In this milk they were kept immerſed above half an hour; and when taken out they were all found alive. They began to breathe, and to diſcharge ſome moiſture by the mouth. Having allowed them to reſpire for half an hour, I again put them into warm milk, and left them a ſecond half-hour; at the expiration of which two of them were taken out vigorous and ſeemingly no wiſe incommoded, but the third appeared rather in a languiſhing ſtate; this I cauſed to be carried to the mother, which by this time had produced, in the natural way, ſix other puppies; and though it had been brought forth in water, and had lived in milk one half hour before, and another after it had breathed, it yet received ſo little injury from the experiment, that it preſently recovered and was as ſtrong and lively as the reſt of the litter. After allowing the other two about an hour to breathe, I put them once more into the warm milk, in which they remained another half hour. Whether they ſwallowed any of this liquor or not is uncertain; but on being taken out they appeared nearly as vigorous as ever. After being carried to the mother, however, one died the ſame day; but whether by any accident, or by what it had ſuffered while immerſed in the liquid, and deprived of air, I could not determine. The other lived, as well as the firſt, and both throve equally with thoſe which had not gone through the ſame trials. This experiment I never carried farther; but I ſaw enough to convince me that reſpiration is leſs neceſſary to a new-born, than to a grown animal; and that it might be poſſible, with proper precautions, to keep the foramen ovale from being cloſed, and thus produce excellent divers, and different kinds of amphibious animals, which might live equally in air or in water.

The air, on its firſt admiſſion into the lungs, generally meets with ſome obſtacle, occaſioned by a liquid collected in the wind-pipe. This obſtacle is more or leſs great, in proportion as the liquid is more or leſs viſcous. At its birth, however, the infant raiſes its head, which before reclined on its breaſt, and by this movement the canal of the wind-pipe is lengthened, the air obtains a place, and forces the liquid into the lungs; and by dilating the bronchia, it diſtributes over their coats the mucous ſubſtance which oppoſes its paſſage. The ſuperfluity of this moiſture is preſently dried up by the renewal of the air; or, if the infant is incommoded by it, it coughs, and at length relieves itſelf by expectoration, which, as it has not yet the ſtrength to ſpit, is ſeen to flow from the mouth.

As we remember nothing of what happened to us at this period, it is impoſſible to determine what feelings the impreſſion of air produces in a new-born infant. Its cries, however, the inſtant it firſt draws breath, are pretty certain ſigns of the pain it feels from the action of the air. Till the moment of its birth, the infant is accuſtomed to the mild warmth of a tranquil liquid; and we may ſuppoſe, that the action of a fluid, whoſe temperature is unequal, gives too violent a ſhock to the delicate fibres of its body. By warmth and by cold it ſeems to be equally affected; in every ſituation it complains, and pain appears to be its firſt, its only ſenſation.

For ſome days after they are brought into the world, moſt animals have their eye-lids cloſed. Infants open them the moment of their birth, but they are fixed and dull; they want that luſtre which they afterwards acquire; and when they move, it is rather an accidental roll than an act of viſion. The pupil of the eye is ſeen to dilate or contract in proportion to the quantity of light it receives, yet is incapable of diſtinguiſhing objects, becauſe the organs of viſion are ſtill imperfect; the tunica cornea, or horny tunicle, is wrinkled, and perhaps the retina is alſo too ſoft to receive the images of external objects, and admit the ſenſe of ſeeing.

The ſame remark is equally applicable to the other ſenſes; they have not acquired that conſiſtency which is neceſſary to their operations; and even when they have, a long time muſt elapſe before the ſenſations of the infant can be juſt and complete. The ſenſes are ſo many inſtruments which we muſt learn to employ. Of theſe ſight, which ſeems to be the nobleſt and the moſt admirable, is alſo the moſt uncertain and deluſive; and were its effects not every moment corrected by the teſtimony of touching, we ſhould conſtantly be miſled and draw falſe concluſions. This ſenſe of touching is the meaſure and criterion of all the others; it alone is eſſential to the animal's exiſtence; and is alone diffuſed univerſally over its body. Yet even this ſenſe, in an infant juſt born, is imperfect; by its cries, indeed, it gives indications of pain; but it has no expreſſion to denote pleaſure. It is forty days before it begins to ſmile; about the ſame time alſo it begins to weep; its former expreſſions of pain being unaccompanied with tears. On the countenance of a new-born infant there appears no veſtige of the paſſions, the features of the face not having acquired that conſiſtence and form which are neceſſary for expreſſing the ſentiments of the ſoul. All the other parts of its body are alike feeble and delicate; its motions are unſteady and uncertain; it is unable to ſtand upright; its legs and thighs are ſtill bent, from the habit it contracted in the womb; it has not ſtrength enough to ſtretch forth its arms or to graſp any thing with its hands; and if abandoned, it would remain on its back, without being able to turn itſelf.

From all which it appears, that the pain felt by infants ſoon after their birth, and which they expreſs by crying, is a ſenſation merely corporeal, ſimilar to that of other animals, who alſo cry the minute they are brought forth; as alſo, that the mental ſenſations do not begin to manifeſt themſelves till forty days have elapſed; ſmiling and weeping being produced by two internal ſenſations, which both depend on the action of the mind. The former is the effect of an agreeable emotion, which can only ariſe from the ſight, or reſemblance of an object known, beloved, and deſired; the latter is that of a diſagreeable impreſſion, compounded of ſympathy, and anxious concern for ourſelves; both imply a certain degree of knowledge, as well as an ability to compare and to reflect. Smiles and tears, therefore, are ſigns peculiar to the human ſpecies, for expreſſing mental pleaſure or pain; while cries, and the other ſigns of bodily pain and pleaſure, are common to man, and to the greateſt part of the animal creation.

But let us return to the material organs and affections of the body. The ſize of an infant born at the full time is uſually about twenty-one inches; this is not without exception, ſome falling ſhort of and others exceeding this meaſurement. In children of twenty-one inches, the breaſt, meaſured by the length of the ſternum, is nearly three inches; and in thoſe of fourteen, only two inches. At nine months, the fœtus generally weighs from twelve to fourteen pounds. The head is large in proportion to the reſt of the body; but this diſproportion gradually wears off as the ſize of the child encreaſes. Its ſkin is very ſoft; and from its tranſparency, by which the blood beneath appears, it is alſo of a reddiſh caſt. It is even pretended, that thoſe children whoſe ſkins are the moſt red when born, will afterwards be the faireſt and the moſt beautiful.

The form of the body and the members of a new-born infant are by no means perfect: all the parts are too round, and even when the child is in good health they ſeem ſwelled. At the end of three days there generally appears a kind of jaundice; and at this time there is generally milk in the breaſts of the infants, which is ſqueezed out with the fingers. The ſuperfluous juices, and the ſwelling of the different parts diminiſh by degrees, as the child increaſes in growth.

In ſome children juſt born, the brain-pan may be obſerved to palpitate; and in all, the action of the ſinuſſes, or arteries of the brain, may be felt at this place. Over this aperture is formed a kind of ſcurf, which is ſometimes very thick, and muſt be rubbed with bruſhes in proportion as it begins to dry. This matter ſeems to have ſome analogy with that of the horns of ſome animals, which alſo derive their origin from an aperture of the ſkull, and from the ſubſtance of the brain. We ſhall hereafter take an opportunity to ſhew, that the extremities of the nerves become ſolid by being expoſed to the air, and that it is this nervous ſubſtance which produces claws, nails, horns, &c.

The fluid contained in the amnios leaves a viſcous, whitiſh matter upon the infant, which is ſometimes ſo adheſive, that it muſt be diluted with ſome mild liquor before it can be removed. In this country we never waſh the infant but in warm water; yet there are whole nations, who inhabit climes much more ſevere than ours, that plunge their children into cold water the minute they are born, without their ſuffering the leaſt injury. The Laplanders are even ſaid to leave their infants in ſnow, till by the cold their reſpiration is nearly ſtopped, and then plunge them into a bath of warm water. They are treated thus roughly thrice every day during the firſt year, and afterwards as often every week, do they undergo an immerſion in cold water. The people of the North are perſuaded that the practice of cold bathing renders men more healthy and robuſt; and it is for this reaſon they enure their progeny to it from their birth.

The truth is, we are ignorant with the extent of what our body is capable of ſuffering, acquiring, or loſing by the power of habit. The Indians in the iſthmus of America, for example, receive no injury from plunging into cold water when in a ſweat; and as the moſt ſpeedy remedy for intoxication, the women throw their huſbands into the river when they are drunk; the minute after delivery, mothers ſcruple not to bathe in cold water with their infants, and yet dangerous as we ſhould conſider this practice, theſe women are rarely known to die in child-bearing.

A few minutes after birth the infant diſcharges urine, and this generally when it feels the heat of the fire; and ſometimes alſo the meconium or excrement which had been collected in the inteſtines during its reſidence in the matrix. This laſt evacuation is not always performed ſo ſoon, but if it does not happen in the courſe of the firſt day, the child is often affected with a pain in the bowels; in which caſe methods are taken to facilitate the diſcharge. The meconium is black, and when the infant is effectually eaſed of it, the ſubſequent ſtools are of a whitiſh caſt. This change generally happens on the ſecond or third day, and then the excrement becomes more fœtid than the meconium; a proof that the bile and other bitter humours of the body begin to intermix with it. This fact tends to ſupport our former remark, that the fœtus did not receive any food by its mouth, but received all its nouriſhment by abſorption.

The infant is allowed time to throw off the ſlime and meconium, which are in its bowels and inteſtines, before it is allowed to ſuck. As theſe ſubſtances might ſour the milk, and produce bad effects, it is firſt made to ſwallow a little wine and ſugar, in order to fortify the ſtomach, and to procure ſuch evacuations as may be neceſſary to prepare it for receiving and digeſting its food; nor ought it to receive the breaſt till 10 or 12 hours after the birth.

Hardly has the infant left the womb of its mother, and enjoyed the liberty of extending its limbs, when it is again put into a more cruel confinement. The head of the helpleſs infant is fixed to one poſition; its arms and legs put in ſtrict bondage, and it is laced with bandages ſo ſtrait as not to be able to move a ſingle joint. Well is it when the compreſſion is not ſo great as to obſtruct the reſpiration, or that the midwife has taken the precaution to lay it upon its ſide, that the natural moiſture may emit of itſelf from the mouth, ſince it is denied the power of turning its head in order to facilitate this emiſſion. Do not then thoſe nations act more wiſely than we who cover or clothe their children without ſhackling them in ſwathing-bands? the Siameſe, the Japaneſe, the Indians, the Negroes, the Savages of Canada, of Virginia, or Brazil, and almoſt all the inhabitants of South America, lay their infants naked upon a ſuſpended bed of cotton, or put them into their cradles lined with fur. Thoſe practices are certainly liable to leſs inconveniencies than ours. In ſwaddling a child, it is impoſſible but the reſtraint muſt give it uneaſineſs; and the efforts it makes to diſentangle itſelf have a greater tendency to injure the form of the body, than any poſition it might aſſume was it left at full liberty. Swathing-bands may be compared to ſtays, which young girls are made to wear in order to preſerve their ſhapes, but which nevertheleſs occaſion more diſeaſes and deformities than they are ſuppoſed to prevent.

If the efforts which children make for liberty, when confined in the ſwaddling-cloaths, are hurtful, the inaction in which they are held by it, is perhaps ſtill more ſo. Want of exerciſe naturally retards the growth of their limbs, and diminiſhes the ſtrength of their bodies;

and of conſequence ſuch children as enjoy the liberty of moving at pleaſure, muſt be the moſt vigorous. It was for this reaſon that the ancient Peruvians gave their infants the full freedom of their arms, in a ſwathing-bag; afterwards, as their children grew, they put them up to the middle in a hole dug in the earth, and lined with linen; by this method they had their arms free, and could move their heads and bend their bodies, without falling or hurting themſelves. So ſoon as they were able to ſtep, they were preſented with the breaſt, at a little diſtance, as an incentive for them to walk. The children of Negroes are often expoſed to much greater fatigues, in order to come at the nipple, they cling round one of their mother's haunches with their legs, and ſupport themſelves without any aſſiſtance from her; ſeizing the breaſt they continue to ſuck in perfect ſafety, notwithſtanding ſhe is all the while in motion, or at work. Theſe children begin to walk, or rather creep on their kees and hands, in the ſecond month; and this exerciſe qualifies them for running afterwards in this manner, almoſt as nimble as they do upon their feet.

END OF THE THIRD VOLUME.

In
price
held.
Re